

APPENDICES

Appendix A

**Envirocorp Report
Site Suitability Feasibility Study, March, 1997**

**SITE SUITABILITY FEASIBILITY STUDY
NON-HAZARDOUS INJECTION WELL FACILITY
FOR
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA**

Project No. 30A4278

May 1997

Prepared And Submitted By:

**ENVIROCORP SERVICES & TECHNOLOGY, INC.
South Bend, Indiana**

TABLE OF CONTENTS

EXECUTIVE SUMMARY	viii
1.0 INTRODUCTION	1
2.0 AREA OF REVIEW	2
2.1 Method of Determination of the AOR	2
2.2 Procedures and Results of Search for Artificial Penetrations	2
3.0 GEOLOGY	3
3.1 Regional Geologic Structure	6
3.2 Regional Stratigraphy	7
3.2.1 Precambrian Basement	9
3.2.2 The Cambrian System	9
3.2.3 The Ordovician System	10
3.2.4 The Silurian System	13
3.2.5 The Devonian System	14
3.2.6 The Mississippian System	15
3.2.7 The Pennsylvanian System	17
3.2.8 Pleistocene	19
3.3 Local Geology	19
3.4 Seismic Activity	26
4.0 CONCLUSIONS AND RECOMMENDATIONS	28
4.1 Conclusions	28
4.2 Recommendations	30
5.0 GEOLOGIC REFERENCES	30

TABLE OF CONTENTS (Continued)

- FIGURE 3.2.3-2: Map Showing the Thickness of the Shakopee Dolomite in Indiana
- FIGURE 3.2.3-3: Map Showing the Thickness and Distribution of the Ancell Group in Indiana
- FIGURE 3.2.3-4: Map Showing the Thickness and Distribution of the St. Peter Sandstone in Indiana
- FIGURE 3.2.3-5: Map Showing the Thickness and Distribution of the Dutchtown Formation in Indiana
- FIGURE 3.2.3-6: Map Showing the Thickness and Distribution of the Joachim Dolomite in Indiana
- FIGURE 3.2.3-7: Map Showing the Thickness and Distribution of the Black River Group in Indiana
- FIGURE 3.2.3-8: Map Showing the Thickness and Distribution of the Pecatonica Formation in Indiana
- FIGURE 3.2.3-9: Map Showing the Thickness and Distribution of the Platin Formation in Indiana
- FIGURE 3.2.3-10: Map Showing the Thickness and Distribution of the Trenton and Lexington Limestone in Indiana
- FIGURE 3.2.3-11: Map of Indiana Showing Total Thickness of the Maquoketa Group and Approximate Net Thickness of Terrigenous Clastic Rocks in the Group
- FIGURE 3.2.3-12: Map Showing Thickness and Lithofacies Interpretations of Unit B, Maquoketa Group
- FIGURE 3.2.3-13: Map Showing Thickness and Lithofacies Interpretations of Unit C, Maquoketa Group
- FIGURE 3.2.3-14: Map of Indiana Showing Structural Configuration on Top of the Maquoketa Group
- FIGURE 3.2.4-1: Isopach Map of the Silurian System and Locations of Reefs in Southwestern Indiana That Have Induced Structure in Younger Rocks

TABLE OF CONTENTS (Continued)

FIGURE 3.2.7-4:	Columnar Section Showing Exposed Pennsylvanian Rocks in Indiana
FIGURE 3.2.7-5:	Map of Indiana Showing Thickness of the Lower Part of the Pennsylvanian System
FIGURE 3.3.1-1:	Map of Indiana Showing Structure on Top of the Mt. Simon Sandstone
FIGURE 3.3.1-2:	Map of Indiana Showing Thickness of the Mt. Simon Sandstone
FIGURE 3.3.1-3:	Map of Indiana Showing Thickness of the Eau Claire Formation
FIGURE 3.3.1-4:	Map of Indiana Showing Structure on Top of the Knox Supergroup
FIGURE 3.3.1-5:	Map of Indiana Showing Structure on Top of the Black River Group
FIGURE 3.3.1-6:	Map of Indiana Showing Structure on Top of the Trenton Limestone
FIGURE 3.3.1-7:	Map of Indiana Showing Structure on Top of the Salamonie Dolomite
FIGURE 3.3.1-8:	Map of Indiana Showing Thickness of the New Harmony Group
FIGURE 3.3.1-9:	Map of Indiana Showing Thickness of the North Vernon Limestone
FIGURE 3.3.1-10:	Map of Indiana Showing Structure on Top of the Blue River Group
FIGURE 3.3.1-11:	Map of Indiana Showing Structure on Top of the West Baden Group
FIGURE 3.3.1-12:	Map Illustrating Location of Abandoned Coal Mine Underlying Scepter Site
FIGURE 3.3.1-13:	Map of Knox County Showing the Elevation Relative to Mean Sea Level of the Top of the Springfield Coal Member
FIGURE 3.4-1:	Seismic Risk Map
FIGURE 3.4-2:	Map of Regional Tectonic Setting Illustrating Location of Wabash Valley Fault System

EXECUTIVE SUMMARY

In order to aid Scepter Industries, Inc. (Scepter) in an assessment of the suitability of the site surrounding their Bicknell, Indiana facility for possible deep well injection of their non-hazardous wastestream, Envirocorp Services & Technology, Inc. (Envirocorp) conducted an investigation of the geologic and hydrologic conditions likely to be encountered by a deep injection well at the site. In addition, Envirocorp performed a search for deep artificial penetrations (oil, gas, mineral, and injection wells) within a set radial area surrounding the Scepter site.

Five artificial penetrations greater than 750 feet in depth were located within the two mile radius area of review (AOR). These wells range in depth from 1,395 feet to 2190 feet. The presence of these wells precluded consideration of the uppermost potential injection interval, the Mississippian Age Cypress Sandstone. These wells did not penetrate the confining zones for any of the five other potential injection intervals.

The five other potential injection intervals consist of: 1) the Mt. Simon Sandstone; 2) the Shakopee and St. Peter Formations that occur on either side of the Knox unconformity; 3) the Trenton Formation; 4) the formations of the Bainbridge Group and the Backbone Limestone of the New Harmony Group; and 5) the formations of the Muscatatuck Group. Envirocorp recommends that the Mt. Simon not be considered as a target injection interval due to its greater depth. All formation depths and thicknesses are reported in Table 3.3.1-I. Regional geologic publications listed in the bibliography to this report (Section 5.0) indicate that any or all of the potential injection intervals may exhibit sufficient permeability and porosity to allow for injection of reasonable quantities of fluids. In addition, all of these potential reservoirs are of sufficient thickness and areal extent to prevent migration of injected fluid into the Underground Sources of Drinking Water (USDW).

The Shakopee/St. Peter injection interval in the vicinity of Scepter consists of approximately 850 feet of sandstone and limestone. The top 150 to 200 feet of rock are likely to provide the best reservoir because most of the sandstone is likely to occur in this interval along with weathered and jointed limestone. The Trenton Formation consists of approximately 125 feet of limestone. The Trenton is known to contain porosity and permeability, and also to contain oil in east-central Indiana, in southern Illinois, and in many other parts of the eastern United States. It is not known whether the Trenton in the vicinity of Scepter will exhibit the properties necessary for an injection reservoir. The formations of the Bainbridge Group and the Backbone Limestone consist of approximately 700 feet of limestone. Included in the Bainbridge Group are likely to be reef formations that are expected to provide sufficient porosity and permeability to provide a reservoir. The Backbone Limestone is considered to be a potential gas storage reservoir in southwestern Indiana (Rupp, 1986), and may contain sufficient porosity and permeability to create an excellent injection reservoir in the vicinity of Scepter. The Jeffersonville and North

1.0 INTRODUCTION

Envirocorp Services & Technology, Inc. (Envirocorp) was contracted by Scepter Industries, Inc. (Scepter) to conduct a Site Suitability Feasibility Study for deep well injection at their facility in Bicknell, Indiana. The purpose of the study is to determine if the site is suitable for the installation of a non-hazardous Class I waste injection well as set forth in 40 CFR Subpart 146.11. Most new non-hazardous Class I wells are evaluated according to siting criteria for Hazardous Class I wells (40 CFR Subpart 146.62); therefore, these criteria are used as a standard for this site feasibility study. A copy of these siting criteria is included in Attachment A. The economic and operational feasibility of such a well installation are to be examined in separate reports should the site appear to be physically suitable.

The site suitability study was conducted according to the following outline:

- I. Compilation of Data
 - A. Artificial Penetrations
 - 1. Base maps
 - 2. Well completion reports
 - 3. Well plugging and abandonment reports
 - B. Geologic
 - 1. Base maps
 - 2. Topographic Maps
 - 3. Published geologic reports and maps
 - 4. Geophysical logs
 - 5. Well completion reports
 - 6. Well plugging and abandonment reports
 - 7. Well sample descriptions
 - 8. Seismic occurrences
 - C. Hydrologic
 - 1. Base maps
 - 2. Published hydrologic reports and maps
 - 3. Water well records
- II. Evaluation of Data
- III. Report

The following sections summarize pertinent siting information and identify those factors that affect site suitability.

of Oil and Gas in Indianapolis. The five wells and their depths are listed in Table 2.1-I. Well locations are indicated on Figure 2.1-1. Well records obtained for these wells are contained in Attachment B. All of the five wells were plugged from total depth to approximately 450 feet with drilling mud. Cement plugs ranging in depth from 50 to 200 feet were placed beneath the coal seams at a depth of 450 feet to 250 feet. It is doubtful that the United States Environmental Protection Agency (USEPA) will consider this method of plugging adequate to prevent possible migration of formation fluid upward into USDWs through improperly sealed boreholes. These wells would pose a permitting problem if any of the wells penetrated the proposed injection zone, and if the calculated AOR for the well was greater than one mile.

TABLE 2.1-I

Artificial Penetrations Greater Than 750' in Depth Within the AOR

<u>Well No.</u>	<u>Well Name</u>	<u>Well Location</u>	<u>Total Depth</u>	<u>Formation</u>
1	Clyde Wampler No. 1	Don 149, T4N, R8W	2170'	Muldraugh
2	Mont & B. Freeland No. 1	Don 149, T4N, R8W	1816'	Salem
3	Long No. 1	Don 124, T4N, R8W	2190'	Muldraugh
4	Chas & Eva McBride No. 1	Don 121, T4N, R9W	1965'	Salem
5	Rob. & Hul. Miller No. 1	Sec 9, T4N, R8W	1395'	St. Louis

3.0 GEOLOGY

The following sections discuss the regional and local geology associated with the proposed injection well. The information contained herein provides evidence this site meets the requirements of the geologic siting criteria for a hazardous waste injection well (although the proposed well is non-hazardous), as set forth in 40 CFR Subpart G 146.62. Based on available data, the Scepter site meets or exceeds all geological parameters for the safe operation of non-hazardous injection wells. Geologic siting criteria spelled out in 40 CFR 146.62 are summarized below.

- a. The regional injection and confining units should be continuous and lack complex geologic structure.
- b. There should be minimal regional seismic activity.
- c. There should be no mineral resources within the injection zone in the AOR.

The lowermost USDW within the AOR is estimated to be at a depth of approximately 470 feet (0 MSL [mean sea level]) within the Pennsylvanian Age bedrock by Mitchell and Rupp (1994). For the purpose of delineating a definable aquifer as the lowermost USDW, the bottom of the Pennsylvanian Age Linton Formation (Carbondale Group) at a depth of -75 feet MSL (555 feet BGL [below ground level]) is considered to be the base of the lowermost USDW.

Within the AOR, primary arrestment and confinement would be provided by over 600 feet of shale and dense carbonates of the lower Mississippian and Upper Devonian Age Formations if the North Vernon or Jeffersonville Formations were used as the injection interval. If a Silurian or Ordovician Age aquifer were used, it would be overlain by 1,400 to 2,200 feet of sandstone, shale, and limestone. In both cases, secondary confinement would be provided by over 1,500 feet of dense carbonates and shales below the estimated USDW. The nature and extent of the proposed injection and confining zones are discussed in greater detail in Sections 3.2 and 3.3.

No complex geologic features, such as faults or extensive fracture zones, are known to exist within the AOR. The structural geology in the immediate vicinity of the Scepter site is discussed in Section 3.1. The region surrounding the Scepter site is tectonically stable, and the risk of induced earthquakes is minimal, as is discussed in Section 3.4.

No mineral or petroleum resources of any economic value are expected to be present within the injection or confining zones within the two mile AOR. Depositional environments during the Paleozoic in the region of Scepter were suitable for the deposition of laterally continuous sedimentary units, as described in Section 3.2. After deposition, these units were downwarped and gently tilted, resulting in regional dip to the southwest.

The injection zone, confining zone, and overlying units are laterally continuous, with no abrupt changes in thickness or lithology within at least a 10 mile radius of Scepter. The Ordovician Age units dip at approximately 100 feet per mile toward the southwest.

Section 3.4 discusses the lack of seismic events in the immediate vicinity of Scepter. Earthquakes which have occurred within 100 miles of Scepter have all been orders of magnitude less than the intensity which would be required to damage a well. The closest epicenter of an earthquake recorded was more than 10 miles from the proposed injection site.

The following discussions detail regional and local geology in the vicinity of the Scepter site in Township 4 North, Range 8 West, Donation 148. The depositional history and lithologic and stratigraphic portions of this report fully establish the integrity of the possible injection

Figure 3.1-4 illustrates the major faults and some anticlinal belts in the Illinois Basin. The Wabash River Valley fault system contains the only known faults within 75 miles of the Scepter site. This fault system is located more than 50 miles from the site. The Wabash Valley System is comprised of high angle normal faults. Displacements of this fault system have been reported to be several hundred feet (Nelson and Lumm, 1984).

3.2 Regional Stratigraphy

The sedimentary rocks underlying Scepter are comprised mainly of marine sediments deposited during the Paleozoic Era. These consolidated bedrock units are comprised of dolomite, limestone, sandstone, siltstone, and shale, and are of Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, Cambrian, and Precambrian Ages. Approximately 50 feet of glacial alluvium overlies the consolidated rocks. Most geologic units underlying the Scepter site dip approximately 100 feet per mile toward the southwest into the center of the Illinois Basin.

Most geologic information is interpreted from driller's descriptions and geophysical logs run on exploration wells previously drilled in an area. In Indiana, only 24 wells have penetrated through the entire sequence of sedimentary rocks to the underlying Precambrian basement, and all but three of these wells lie along the Cincinnati and Kankakee Arches, where the depth to the basement is less than 4,600 feet. Data for the deeper rock units is therefore derived from extrapolation of geologic data from these few available test wells and on interpretation of geophysical data obtained from gravity, magnetic, electrical, and seismic surveys. Only one well in Knox County penetrates into the Ordovician Age Knox Formation. Records for this well, and for other Knox wells in surrounding counties in Indiana and Illinois, were obtained in order to extrapolate the geology at the Scepter site. A number of wells have been drilled within a 10 mile radius of the Scepter site into the Mississippian Age rocks at depths of 1,300 to 2,700 feet. Records for representative wells were obtained.

The following text provides regional geologic information for the area surrounding the Scepter site. A simplified stratigraphic column illustrating the estimated formation tops and thicknesses is provided in Table 3.3.1-I. Table 3.3.1-I was created from very limited available geologic data and chosen formation thicknesses and formation tops should be considered to be very preliminary. The stratigraphic nomenclature used throughout this report was obtained from Shaver and others (1986).

TABLE 3.3.1-1 (Continued)

Estimated Formation Tops and Thickness

<u>Group</u>	<u>Formation</u>	<u>Approximate Depth (BGL)*</u>	<u>Approximate Depth (MSL)**</u>	<u>Approximate Thickness</u>	<u>Age</u>
(Knox) Prairie du Chien	Shakopee Dol	4680'	-4200'	800'	O
(Knox) Prairie du Chien	Oneata Dol	5480'	-5000'	400'	O
(Knox) Prairie du Chien	Potosi Dol	5880'	-5400'	1400'	C
(Potsdam) Munising	Eau Claire Fmn	7280'	-6800'	1000'	C
(Potsdam) Munising	Mt. Simon Ss	8280'	-7800'	1200'	C
	Precambrian	9480'	-9000'	-----	PC

Geologic Time Periods

Quaternary = Q

Pennsylvanian = P

Mississippian = M

Devonian = D

Silurian = S

Ordovician = O

Cambrian = C

Precambrian = PC

* BGL = Below Ground Surface

** MSL = Mean Sea Level

3.2.1 Precambrian Basement

The basement complex in most of Illinois and Indiana, including the vicinity of the Scepter site, has been identified as being part of the Central Granite-Rhyolite Province. The location of this province is delineated on Figure 3.1-2. The general lithology of the Central Granite-Rhyolite Province is an anorogenic granitic or felsic intrusive terrain. The Precambrian basement is thought to occur at approximately 9,500 feet, and to be comprised of granite or rhyolite in the vicinity of the Scepter site. No specific information is available regarding the nature of the Precambrian rocks in the vicinity of Scepter.

3.2.2 The Cambrian System

The Cambrian System is found throughout the Illinois Basin. It is comprised, in descending order, of the Potosi Dolomite, the Munising Group, and the Mt. Simon Sandstone. The Munising is divided into the Davis Formation and the Eau Claire Formation. Sandstones are a dominant lithology of the system, with dolomites becoming more prevalent in the upper part of the system. Figure 3.2.2-1 shows that rocks of the Cambrian System in Indiana range from less than 1,500 feet to more than 4,000 feet in thickness.

The Shakopee Dolomite is a member of the Prairie du Chien Formation. Figure 3.2.3-2 illustrates that the thickness of the Shakopee Dolomite in Indiana ranges from 0 feet in the northern part of the state to an estimated 1,200 feet in the southwestern corner of Indiana. The Shakopee Dolomite is pure to impure and very fine-grained to fine-grained dolostone with interbeds of shale, siltstone, and sandstone. Sandstone beds generally as much as several tens of feet thick are present in southeastern Indiana. The Shakopee of Illinois also contains sandstones (Willman and Buschbach, 1975).

The Ancell Group ranges from 0 to more than 450 feet in thickness in Indiana, as illustrated in Figure 3.2.3-3. Droste and others (1982) state that it lies with significant unconformity on either the Knox Dolomite or the Everton Dolomite below, and is overlain by the Black River Group with sharp contact probably representing a minor erosional discontinuity. The lowermost member of the Ancell Group is the St. Peter Sandstone. The St. Peter ranges in thickness from 0 feet to over 170 feet in Indiana. Sharp differences in thickness over a few tens of miles have been observed and are thought to result from moderate relief developed along the unconformity on the subjacent Knox rocks before St. Peter deposition and because of facies changes from St. Peter rocks to Dutchtown or Joachim rocks within short distances (Droste and others, 1982). Abruptly increased thickening (as much as 200 additional feet is observed in some wells in northwestern Indiana) over short distances within the continuous body of the St. Peter is also known. Sinkholes, karst-solution valleys, or similar box-canyon features developed on the Knox erosion surface could be the reason for the abrupt thickening.

Generally, the St. Peter is composed of fine to medium well-rounded and well-sorted frosted grains of quartz that are weakly cemented. In some places, secondary quartz overgrowths and siliceous intergranular cement produce well-indurated rather than friable sandstone. In southern Indiana, the St. Peter may have carbonate cement and thin interbeds of carbonate rock, generally dolomite (Droste and others, 1982).

The Dutchtown Formation within the Ancell Group has a transitional contact with the St. Peter in the area where the Dutchtown is present. Figure 3.2.3-5 indicates the thickness and distribution of the Dutchtown in Indiana. The Dutchtown Formation in Indiana correlates with the Wells Creek Formation in Ohio. The Dutchtown is comprised of light-gray and brown partly argillaceous dolomite with some thin interbeds of green shale. In areas where the unit shows a transitional boundary with the St. Peter Sandstone, dolomite cemented medium-grained sandstone is present.

The Joachim Dolomite has the greatest subsurface distribution of the three formations of the Ancell Group (Figure 3.2.3-6). The Joachim is thought to have a thickness of greater than 150 feet in southwestern Indiana. The Joachim consists of varicolored limestone and

The Fort Atkinson Limestone of the Maquoketa Group overlies the Scales Shale. The Fort Atkinson is present in the northern, central, and western portions of Indiana, and is approximately 50 feet thick over most of this area. It includes light-colored, coarsely crystalline limestone and dolomite, mainly in its upper part, and gray argillaceous limestone and calcareous shale, mainly in its lower part. Figure 3.2.3-13 is a map of the thickness and lithofacies interpretations of the combined Fort Atkinson Limestone and the underlying Brainard Shale and their stratigraphic equivalents in Indiana.

The Brainard Shale is thought to conformably overlie the Fort Atkinson Limestone in northern, central, and southwestern Indiana (Shaver and others, 1986). Over most of its area of recognition, the Brainard is 75 to 100 feet thick. The Brainard consists primarily of gray to greenish-gray shale that contains a few thin interbeds of limestone. It is overlain in central and western Indiana by the Silurian Age Brassfield Limestone or Sexton Creek Limestone. Figure 3.2.3-14 illustrates the structural configuration on top of the Maquoketa Group in Indiana.

3.2.4 The Silurian System

Over most of Indiana, rocks that unconformably overlie the Maquoketa Group are assigned to the Silurian Age Brassfield Limestone. This ranges in lithology from light-colored calcarenite in southeastern Indiana to cherty limestone to shaly limestone in southwestern Indiana. The Sexton Creek Limestone is a distinctive facies of the Brassfield present in the western half to two-thirds of Indiana. The Sexton Creek averages between 40 and 50 feet in thickness (Shaver and others, 1986).

The Sexton Creek is overlain unconformably by the St. Claire Limestone in southwestern Indiana and by the Salamonie Dolomite elsewhere in the state. In southwestern Indiana, the Salamonie has a vertical cutoff boundary with the approximate lower half of the St. Claire Limestone. The Salamonie rocks are generally impure, and include finer grained argillaceous limestone and dolomitic limestone and shale. The St. Claire is a multi-colored medium-grained limestone. The St. Claire ranges from 30 to 90 feet in thickness and averages about 60 feet in thickness in the subsurface of southwestern Indiana. The St. Claire's upper contact with the Moccasin Springs Formation generally involves an upward transition through several feet of interbedded pure limestones and argillaceous limestones (Shaver and others, 1986).

The Moccasin Springs Formation consists mostly of dense to fine-grained, somewhat argillaceous limestones that are interbedded as variably colored units. In most places, the top 20 feet of the formation consists of dark-gray to black dolomitic shale interbedded with dark-greenish-gray very fine-grained argillaceous limestone. Dark red carbonate

medium to coarse-grained, rather pure bioclastic limestone. The Backbone has two prominent intervals of drab cherty dolomitic limestone and dolomitic chert.

South of the Kankakee and Cincinnati Arches, the Muscatatuck Group is comprised of the Jeffersonville Limestone and the North Vernon Limestone. The Jeffersonville consists of the Dutch Creek Sandstone, Geneva Dolomite, and Vernon Fork Members. Figure 3.2.5-2 illustrates the thickness and distribution of the Jeffersonville Limestone. A thin bentonite bed, named the Tioga bentonite bed, acts as a marker for the upper portion of the Jeffersonville in southwestern Indiana, including Knox County. The Jeffersonville consists of fossiliferous limestone. The Dutch Creek Member consists of hard sandy limestone, with sand more abundant at the base of the unit. Where present, the Geneva Dolomite Member consists of brown and tan fine to medium-grained, somewhat massive, finely vuggy dolomite. Figure 3.2.5-3 illustrates the thickness and distribution of the Geneva Dolomite. The Geneva is not thought to be present in Knox County. The Vernon Fork Dolomite in western Indiana is fine to medium-grained, finely vuggy, and mostly brown. Figure 3.2.5-4 illustrates the thickness and distribution of the North Vernon Limestone.

The New Albany Shale conformably overlies the Muscatatuck Group in southwestern Indiana. The New Albany Shale has been divided into five members, which in ascending order are: Blocher; Selmier; Morgan Trail; Camp Run; and Clegg Creek. The uppermost member of the New Albany Shale (Clegg Creek Member) is considered to be Mississippian in age. On the whole, the New Albany has been described as brownish-black carbon-rich shale, greenish-gray shale, and minor amounts of dolomite and dolomitic quartz sandstone (Shaver and others, 1986). Figure 3.2.5-5 illustrates the thickness and distribution of the New Albany Shale in Indiana. The New Albany Shale is approximately 150 feet thick in northern Knox County. Figure 3.2.5-6 is a map showing the structure on the base of the New Albany Shale.

3.2.6 The Mississippian System

The Mississippian System is comprised, in ascending order, of the Clegg Creek Member of the New Albany Shale, the Borden Group, the Sanders Group, the Blue River Group, the West Baden Group, the Stephenson Group, and the Buffalo Wallow Group. The Mississippian rocks are divisible into three lithologically distinct parts. The upper part, which comprises repeated cyclic sequences of sandstone, shale, and limestone and the middle part, which consists principally of limestone of many textural varieties, are restricted to southwestern Indiana. The lower part, a clastic sequence of siltstone and shale, is present in both northern and southwestern Indiana. (Gray, 1979). Figure 3.2.6-1 illustrates the distribution of both Mississippian and Pennsylvanian rocks in Indiana.

Member. In general, the Paoli Limestone is an assortment of lighter colored carbonate rocks ranging from grainstone to mudstone with lesser amounts of interbedded shale and sandstone.

The Blue River Group is conformably overlain by the West Baden Group in southwestern Indiana. The West Baden Group consists in ascending order, of the Bethel Formation, the Beaver Bend Limestone, the Sample Formation, the Reelsville Limestone, and the Cypress Formation. The Group consists dominantly of gray to varicolored shale and mudstone and thin-bedded to crossbedded sandstone; limestone in beds of variable thickness is an important but lesser constituent (Shaver and others, 1986). Figure 3.2.6-6 illustrates that the thickness of the West Baden Group in Knox County varies between 60 and 180 feet. Much of the irregular thickness distribution of the group is caused by large clastic-filled channels that thicken and replace underlying parts of the group and the top of the carbonate rocks of the underlying Blue River Group (Rupp, 1991).

The West Baden Group is conformably overlain by the Stephenson Group in southwestern Indiana. The Stephenson consists, in ascending order, of the Beech Creek Limestone, Big Clifty Formation, Haney Limestone, Hardinsburg Formation, and the Glen Dean Limestone. Lithologically, the units range in composition from clean shale to poorly sorted argillaceous siltstone and fine to medium-grained sandstone. Limestone within the group is predominantly coarse-grained clean bioclastic grainstones. Some formations of the Stephenson Group are thin or absent in much of Knox County. Figure 3.2.6-7 illustrates the thickness and distribution of the Stephenson Group in Indiana.

Where present, the Buffalo Wallow Group conformably overlies the Stephenson Group. In the subsurface, the Group is divided stratigraphically into nine units. In ascending order, these are the Tar Springs Formation, the Vienna Limestone, the Waltersburg Sandstone, the Menar Limestone, the Palestine Sandstone, the Clore Limestone, the Degonia Sandstone, the Kinkaid Limestone, and the Grove Church Shale. Buffalo Wallow rocks include predominantly shale, siltstone, and sandstone with subordinate amounts of limestone. The Buffalo Wallow is unconformably overlain throughout the basin by rocks of Pennsylvanian Age. As a result, there is progressive truncation of older rocks toward the basin margin. Figure 3.2.6-8 illustrates the subcrop limit of the Buffalo Wallow Group. As can be seen from this figure, the Buffalo Wallow is absent from much of Knox County, Indiana.

3.2.7 The Pennsylvanian System

The Pennsylvanian System is comprised of the Raccoon Creek, Carbondale, and McLeansboro Groups. Pennsylvanian rocks are present only in western and southwestern

3.2.8 Pleistocene

The northern and central parts of Indiana are mantled by Pleistocene deposits of glacial and interglacial origin. These clastic sediments are primarily unconsolidated silt, sand, and gravel that are moderately to poorly sorted. Some clay-rich sediments occur as tills and lacustrine and glacial meltwater deposits. Most of the northern deposits are ice-contact sediments, but the more southerly deposits are primarily outwash or meltwater sediments.

3.3 Local Geology

The following text provides local geologic information for the area surrounding the Scepter facility. The information in this section is inferred from published sources containing regional information, and from well drilling records for oil and gas wells drilled in the vicinity of Scepter. Only one existing well in the entire county of Knox intercepts the proposed injection zone. However, there are other deep wells in the counties surrounding Knox in both Indiana and Illinois. Inferences made by Envirocorp and made in published works using data derived from these wells were used to establish likely depths to formation tops in the vicinity of Scepter. Considerable interpolation was required between the sparse well data for all geologic units. It should be noted that these formation tops are estimated with an accuracy not greater than 100 feet.

Drawing 1 illustrates two geologic cross-sections drawn east to west across the State of Indiana. These cross sections illustrate the continuity of rocks comprising the proposed injection and confining zones beneath Scepter. The local continuity of injection and confining intervals can also be demonstrated by regional structure and isopach maps presented in Section 3.2. The structure maps for this area indicate no faulting in the Scepter vicinity, and the isopach maps for this area indicate only regional thickening and thinning of the injection and confining zones.

Several potentially favorable receiving zones for injection activities occur in the vicinity of Scepter. These include the clastic formations of the Mississippian Age West Baden Group, especially the Cypress Formation, formations of the Muscatatuck Group, possible reef structures in the Mocassin Springs and St. Claire Formations of the Silurian Age Bainbridge Group; the Ordovician Age Trenton Limestone; Ordovician Age St. Peter Sandstone in conjunction with the underlying Shakopee Dolomite; and the Mt. Simon Sandstone.

The Cypress Formation is shallow (approximately 1,100 feet), and a well completed into this unit would be relatively inexpensive. However, the Cypress Formation occurs at a shallow enough depth that the nature and quantity of strata present to protect the lowermost

The overlying Oneata Dolomite would also provide confinement to a Mt. Simon reservoir. Figure 3.2.3-1 illustrates the approximate thickness of the Oneata in Indiana. The Oneata is thought to be approximately 400 feet thick in the vicinity of Scepter, and to occur at an approximate depth of 5,000 feet MSL (5,480 feet BGL).

The Shakopee Dolomite in conjunction with the overlying St. Peter Sandstone is a potential injection interval. The Knox unconformity occurs in between the Shakopee and the St. Peter. Natural fractures and higher porosity rock often occurs at the interface between unconformable rocks. The presence of the major erosional unconformity at the top of the Knox Group is likely to provide a zone of good porosity and permeability. Figure 3.3.1-4 illustrates the structure on top of the Shakopee Dolomite (top of the Knox Supergroup).

The Shakopee Dolomite is comprised of fine-grained dolostone with interbeds of shale, siltstone, and sandstone. Although sandstone beds are prominent at the top of the Shakopee in some portions of Indiana (Figure 3.2.3-2), they are not known to be present in the vicinity of Scepter. The Shakopee is thought to be approximately 800 feet thick at the Scepter site, and to occur at an approximate depth of 4,200 feet MSL (4,680 feet BGL).

The St. Peter Sandstone Member of the Ancell Group is comprised of well-rounded and well-sorted quartz grains that are weakly cemented. In southern Indiana, the St. Peter may have carbonate cement and thin interbeds of carbonate rock, generally dolomite. Figure 3.2.3-4 illustrates the approximate thickness of the St. Peter in Indiana. Great increases in thickness of the St. Peter over a small distance are known to occur in northwestern Indiana. Insufficient data exists to infer whether such irregularities in thickness may occur in southwestern Indiana. It is thought that the irregularities may occur due to the presence of erosional features on top of the Knox unconformity. Figure 3.2.3-4 illustrates that the St. Peter is thought to be approximately 50 feet thick in the vicinity of Scepter. It is thought to occur at an approximate depth of 4,150 feet MSL (4,630 feet BGL).

The Dutchtown Formation and the Joachim Dolomite of the Ancell Group would provide immediate confinement above the Shakopee/St. Peter injection zone. Both the Dutchtown and the Joachim are composed of argillaceous dolomite. The Dutchtown contains some thin beds of green shale. Figures 3.2.3-5 and 3.2.3-6 illustrate that the thickness of the Dutchtown Formation is expected to be approximately 100 feet, and the thickness of the Joachim Dolomite is expected to be approximately 150 feet in the vicinity of Scepter. These units are expected to be found at depths of 4,050 feet MSL (4,530 feet BGL) and 3,900 feet MSL (4,380 feet BGL) respectively.

The Pecatonica and Platin Formations of the Black River Group would also act as confinement to a Shakopee/St. Peter reservoir. In southwestern Indiana, the Pecatonica is

chert (Becker, 1974). The Sexton Creek is thought to be approximately 50 feet thick in the vicinity of Scepter.

Possible Silurian reef structures located in the overlying Bainbridge Group would provide another possible injection zone. Reef structures are often porous and permeable and could provide excellent injectivity. The Bainbridge Group is comprised of the St. Claire Limestone, the Mocassin Springs Formation, and the Bailey Limestone. The Scepter site is located near the southwestern edge of the area in which reefs structures are thought to occur in the formations of the Bainbridge. Figure 3.2.4-1 illustrates the combined thickness of the Mocassin Springs, St. Claire, and Sexton Creek Formations, and the locations of reefs in southwestern Indiana. It is unknown if the Salamonie Dolomite is present in the vicinity of Scepter. Figure 3.3.1-7 illustrates the structure on top of the Salamonie Dolomite. Figure 3.3.1-7 also shows that the Scepter site is located very close to the boundary at which the Salamonie Dolomite is no longer recognized because of facies relationship with the St. Claire Limestone. Most recognized large reefs within Indiana occur in the Silurian section above the Salamonie Dolomite. The proximity of the Scepter site to the southwestern boundary of the presence of the Salamonie, and the presence of known reef structures, makes it very difficult to predict the likelihood that a well developed reef structure would be intersected by a Scepter injection well. This is especially true of prediction of the presence of a pinnacle reef structure which would have a breadth of a mile or two at most.

The St. Claire Limestone (or Salamonie Dolomite) is thought to have a thickness of approximately 50 feet in the vicinity of the Scepter site. The overlying Mocassin Springs Formation should have a depth of approximately 300 feet if moderate reef development has occurred. The overlying Bailey Limestone is thought to be approximately 100 feet thick in the vicinity of Scepter. The entire Bainbridge Group may be as much as 200 feet thicker if pinnacle reef development has occurred. Alternately, the Bainbridge Group may be as much as 200 feet thinner than predicted if no reef structure is present in the Mocassin Springs Formation. The top of the Bainbridge Group in the vicinity of Scepter is thought to occur at an approximate depth of 2,650 feet MSL (3,130 feet BGL).

The Devonian Age Backbone Limestone of the New Harmony Group would provide confinement for a Bainbridge injection zone. Alternately, the Backbone may be utilized in conjunction with the Bainbridge as an injection reservoir. Rupp (1986) discusses the potential of the Backbone to be utilized as a reservoir in southern Indiana. The Backbone is a fine to coarse-grained limestone. Figure 3.3.1-8 illustrates that the Backbone is thought to be approximately 250 feet thick in the vicinity of Scepter. It is estimated that it would occur at an approximate depth of 2,400 feet MSL (2,880 feet BGL).

sufficient confinement strata occur between the Cypress and the base of the lowermost USDW. Also, several old improperly plugged boreholes penetrate the Cypress within the two mile AOR. Figures 3.2.6-6 and 3.3.1-11 illustrate that the West Baden Group is thought to be approximately 140 feet thick and to occur at an approximate depth of 660 feet MSL (1,140 feet BGL) in the vicinity of Scepter.

The Stephensport Group is comprised of approximately equal parts of limestone, shale, and sandstone. An erosional unconformity exists between the top of the Stephensport and the overlying Pennsylvanian Age Formations. Rocks of the Mississippian Age Buffalo Wallow Group have been eroded or were not deposited in the vicinity of Scepter. In addition, a portion of the uppermost unit of the Stephensport, the Glen Dean Limestone, has likely been eroded away. Figure 3.2.6-7 illustrates that the Stephensport Group is expected to be approximately 130 feet thick in the vicinity of Scepter. Figure 3.2.7-2 is a map showing the structure on the base of the Pennsylvanian System. Figure 3.2.7-2 indicates that the top of the Stephensport Group occurs at an approximate depth of 530 feet MSL (1,010 feet BGL).

The Pennsylvanian System in the vicinity of Scepter is comprised in ascending order of the Raccoon Creek, Carbondale, and McLeansboro Groups. A number of coal beds are present in the Pennsylvanian strata. Anticlinal and synclinal structures occur in some of the coal beds in Knox County. These structures may be present due to Mississippian structures or topography of the Mississippian-Pennsylvanian unconformity (Harper and Eggert, 1995). Extensive coal mining was performed in the Bicknell area in the 1920s and 1930s. The Knox Consolidated Nos. 1, 2, and 3 mines operated in the Springfield Coal Member of the Petersburg Formation (Carbondale Group) immediately beneath the proposed well site. Figure 3.3.1-12 illustrates the extent and location of this mine. Figure 3.3.1-13 is a map of Knox County illustrating structure on top of the Springfield Coal. Coal exceeding six or seven feet in thickness was removed from this underground mine. Pillars of coal were left in place at regular intervals to prevent the roof of the mine from collapsing. Large quantities of methane were encountered in some places in the mine (Harper and Eggert, 1995). Prior to determining the final location for the injection well, a survey may need to be conducted to locate a pillar that can be drilled through when the well is constructed. Such a pillar would prevent loss of cement circulation should a mined area of coal be encountered during the well construction process. Envirocorp has obtained a map illustrating the general locations of the pillars in the mine underlying Scepter. It may be wise to drill a shallow exploratory well to confirm the presence of a pillar prior to choosing the final well location.

Source: U. S. Geological Survey Earthquake Data Base (National Earthquake Information Center)

All of the earthquakes that have occurred have been mild, having an intensity of VII or less on the Modified Mercalli Intensity Scale (Table 3.4-II), and have been epicentered outside of Scepter's AOR. The closest earthquake had an intensity of VI, and occurred approximately 10 miles from the Scepter site. All but one of the other recorded earthquakes have been at least 30 miles from the site. The most recent earthquake occurred in 1987. This earthquake had an intensity of VI, and was located approximately 32 miles from the Scepter site.

TABLE 3.4-II

Modified Mercalli Intensity (Damage) Scale of 1931
(Abridged)

- I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel Scale.)
- II. Felt only by a few persons at rest, especially on upper floors of building. Delicately suspended objects may swing. (I to II Rossi-Forel Scale.)
- III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated .1. (III Rossi-Forel Scale.)
- IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale.)
- V. Felt by nearly everyone, many awakened. Some dishes, windows, etc. broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, plies, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale.)
- VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale.)
- VII. Everyone runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars. (VIII Rossi-Forel Scale.)

Bainbridge Group and the Backbone Limestone; 5) the formations of the Muscatatuck Group; and 6) the Cypress Sandstone.

- c. The Cypress Sandstone was dismissed from consideration as an injection interval because insufficient strata lie between the Cypress and the lowermost USDW, and because five improperly plugged wellbores intersect the Cypress within the AOR.
- d. The Mt. Simon Sandstone is not recommended as the chosen injection interval because it occurs at a much greater depth than the other potential injection zones, making a Mt. Simon well much more expensive and because it is likely that one of the shallower target zones will serve as an acceptable disposal reservoir.
- e. The lowermost USDW is conservatively estimated to occur in the Pennsylvanian Age Linton Formation. Thus, the base of the lowermost USDW is expected to occur at an approximate depth of 555 feet BGL (-75 feet MSL).
- f. All of the proposed injection and confining units appear to be continuous and to lack complex geologic structure.
- g. The region surrounding Scepter is considered to be one having moderate seismic activity. However, seismic events are expected to originate in the Wabash River Valley fault system, approximately 50 miles outside of the AOR. Seismic intensities are expected to be lower than would be required to severely damage injection well facilities.
- h. No mineral resources are known to occur within any of the proposed injection intervals within the AOR.
- i. Envirocorp believes that sufficient geologic information exists to provide confidence of the safety and suitability of the site.
- j. Each of the proposed injection zones have sufficient thickness and areal extent to prevent migration of fluids into USDWs. Insufficient local geologic information exists to characterize the porosity and permeability of the proposed injection reservoirs with any degree of certainty. However, published data provides evidence of potential reservoir conditions for all the proposed injection zones except the Muscatatuck Group.
- k. Proposed confining zones for each of the potential injection zones are laterally continuous and appear to be free of transecting, transmissive faults or fractures over an area sufficient to prevent the movement of fluids into an USDW.

Bassett, P.A., and Keith, B.D., 1984 (update 1996), Data base for deep wells in Indiana: Indiana Geological Survey Occasional Paper 46, 29p.

Becker, L.E., 1974, Silurian and Devonian rocks in Indiana southwest of the Cincinnati Arch: Indiana Geological Survey Bulletin 50, 83p.

Becker, L.E., 1978, Late Silurian and Early Devonian sedimentologic history of southwestern Indiana: Indiana Geological Survey Occasional Paper 24, 14p.

Becker, L.E., Hreha, A.J., and Dawson, T.A., 1978, Pre-Knox (Cambrian) stratigraphy in Indiana: Indiana Geological Survey Bulletin 57, 72p.

Becker, L.E., and Keller, S.J., 1976, Silurian reefs in southwestern Indiana and their relation to petroleum accumulation: Indiana Geological Survey Occasional Paper 19, 11p.

Blakely, R.F., and Varma, M.M., 1976, The Seismicity of Indiana Described by Return Periods of Earthquake Intensities: Indiana Geological Survey Occasional Paper 16, 13p.

Bond, D.C., 1972, Hydrodynamics in deep aquifers of the Illinois Basin: Illinois State Geological Survey Circular 470, 71p.

Branam, T.D., Ennis, M.D., Comer, J.B., 1994, Assessment of the 3,000 and 10,000 ppm total dissolved solids boundaries in Mississippian and Pennsylvanian Bedrock aquifers of Southwestern Indiana: Chemical Analyses and QA/QC: Indiana Geological Survey Open-File Report 94-1, 7p.

Bristol, H.M. and Treworgy, J.D., 1979, The Wabash Valley Fault System in southeastern Illinois: Illinois State Geological Survey Circular 509, 18p.

Calvert, W.L., 1963, A cross section of sub-Trenton rocks from Wood County, West Virginia, to Fayette County, Illinois: Ohio Division of Geological Survey Report of Investigations 48, 33p.

Cazee, J.T., 1993, Map Showing Oil, Gas, and Gas Storage Fields in Indiana: Indiana Geological Survey Miscellaneous Map No. 58.

Clement, M.W., Strauser, R.L., and Hasenmueller, W.A., 1990, Map of Abandoned Underground Coal Mines in Bicknell Quadrangle: Indiana Geological Survey Miscellaneous Map.

Collinson, C., Sargent, M.L., and Jennings, J.R., 1988, Illinois Basin Region (in Sloss, L.L., ed., Sedimentary Cover-North American Craton:U.S.), The Geological Society of America, Vol. D-2, pp.383-426.

Gray, H.H., 1983, Map of Indiana showing topography of the bedrock surface: Indiana Geologic Survey Miscellaneous Map 39.

Gray, H.H., 1989, Quaternary geologic map of Indiana: Indiana Geological Survey Miscellaneous Map 49.

Gray, H.H., Ault, C.H., and Keller, S.J., 1987, Bedrock geologic map of Indiana: Indiana Geological Survey Miscellaneous Map 48.

Gray, H.H., Wayne, W.J., and Wier, C.E., 1970, Geologic Map of the 1 degree x 2 degree Vincennes Quadrangle and Parts of Adjoining Quadrangles, Indiana and Illinois, showing bedrock and unconsolidated deposits: Indiana Geological Survey Regional Geologic Map No. 3 Parts A and B.

Harper, D., and Eggert, D.L., 1995, Coal Mining in Knox County Indiana: Indiana Geological Survey Special Report 54, 23p.

Hasenmueller, N.R. and Comer J.B., 1994, Gas Potential of the New Albany Shale (Devonian and Mississippian) in the Illinois Basin: Gas Research Institute (Prepared by Illinois Basin Consortium: Illinois State Geological Survey, Indiana Geological Survey, Kentucky Geological Survey) GRI-92/0391, 83p.

Keller, S.J., 1983, Analyses of Subsurface Brines of Indiana: Indiana Geological Survey Occasional Paper 41, 30p.

Keith, B.D., 1985, Map of Indiana showing thickness, extent, and oil and gas fields of Trenton and Lexington Limestones: Indiana Geological Survey Miscellaneous Map 45.

Keith, B.D., 1986, Map of Indiana showing structure on top of and oil productive area of Black River Group (Ordovician): Indiana Geological Survey Miscellaneous Map 46.

Keller, S.J., 1990, Maps of Indiana showing geology and elevation of the Sub-Pennsylvanian Surface: Indiana Geological Survey Miscellaneous Map 51.

Keller, S.J., and Abdulkareem, T.F., 1980, Post-Knox unconformity: significance at Unionport gas-storage project and relationship to petroleum exploration in Indiana: Indiana Geological Survey Occasional Paper 31, 19p.

Keller, S.J., and Becker, L.E., 1980, Subsurface stratigraphy and oil fields in the Salem Limestone and associated rocks in Indiana: Indiana Geological Survey Occasional Paper 30, 63p.

Sullivan, D.M., 1972, Subsurface stratigraphy of the West Baden Group in Indiana: Indiana Geological Survey Bulletin 47, 31p.

Sullivan, D.M., 1995, Natural Gas Fields of Indiana: Indiana Geological Survey Special Report 51, 69p.

Texas World Operations, Inc., September 1992, Cabot Corporation: Permit Renewal Applications - Well Nos. 1 and 2, Tuscola, Illinois.

United States Geological Survey, 1988, 7.5 Minute Topographic Map, Bicknell Quadrangle, Indiana.

United States Geological Survey, 1988, 7.5 Minute Topographic Map, Wheatland Quadrangle, Indiana.

Weber, L.A., 1985, Map of Knox County, Indiana, Showing Locations of Underground Coal Mines: Indiana Geological Survey Coal Map 7.

Zuppmann, C.W., Keith, B.D., 1988, Geology and petroleum production of the Illinois Basin: Joint publication of the Illinois and Indiana-Kentucky Geological Societies, 272p.

FIGURES



SITE LOCATION



Approximate Locations of
Artificial Penetrations
Within the AOR

N



ENVIROCORP

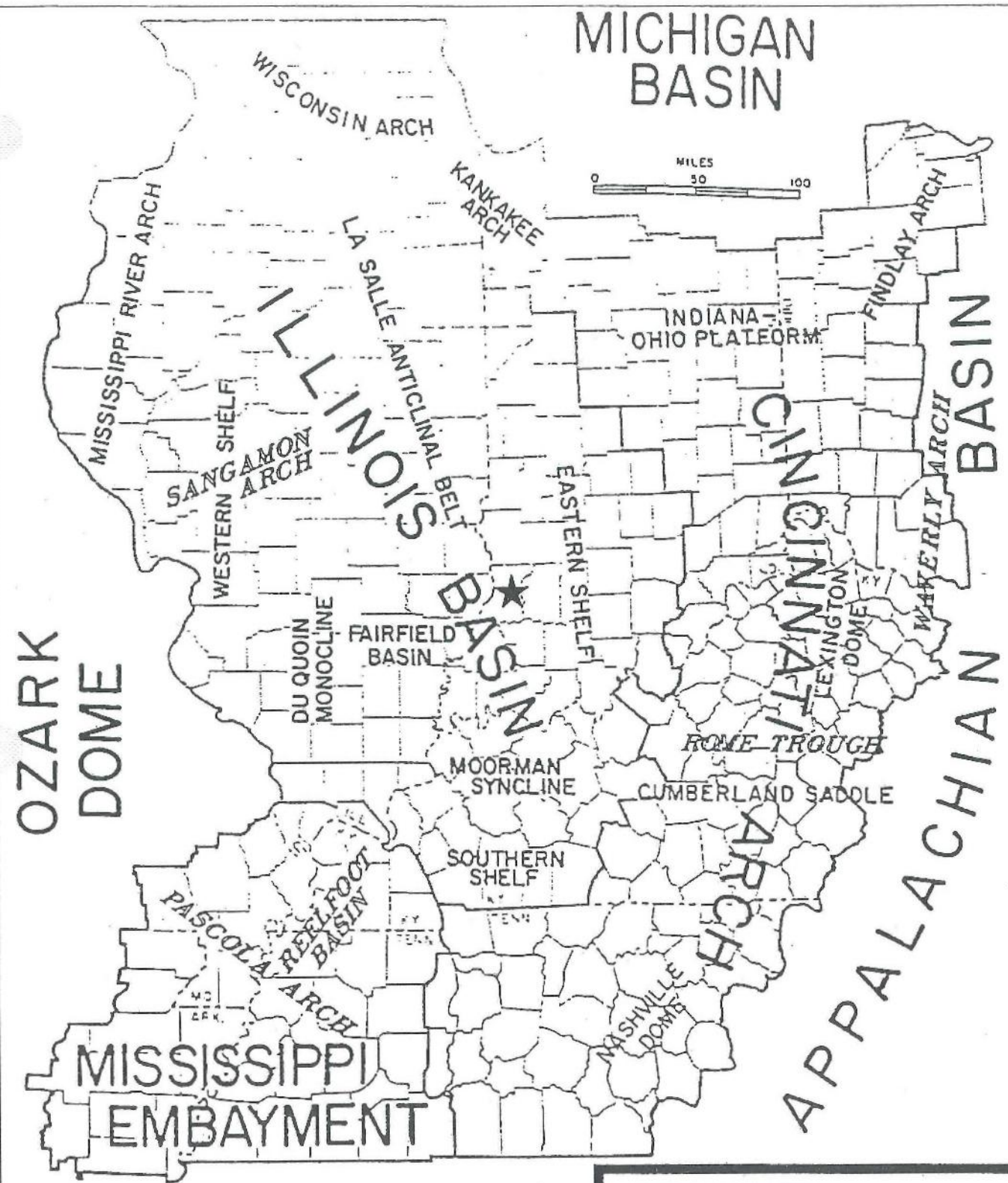
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 2.1-1
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

AREA OF REVIEW MAP

DATE: 5/16/97	CHECKED BY: <i>BW/V</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>LMC</i>	DWG. NO:



★ SITE LOCATION



ENVIROCORP

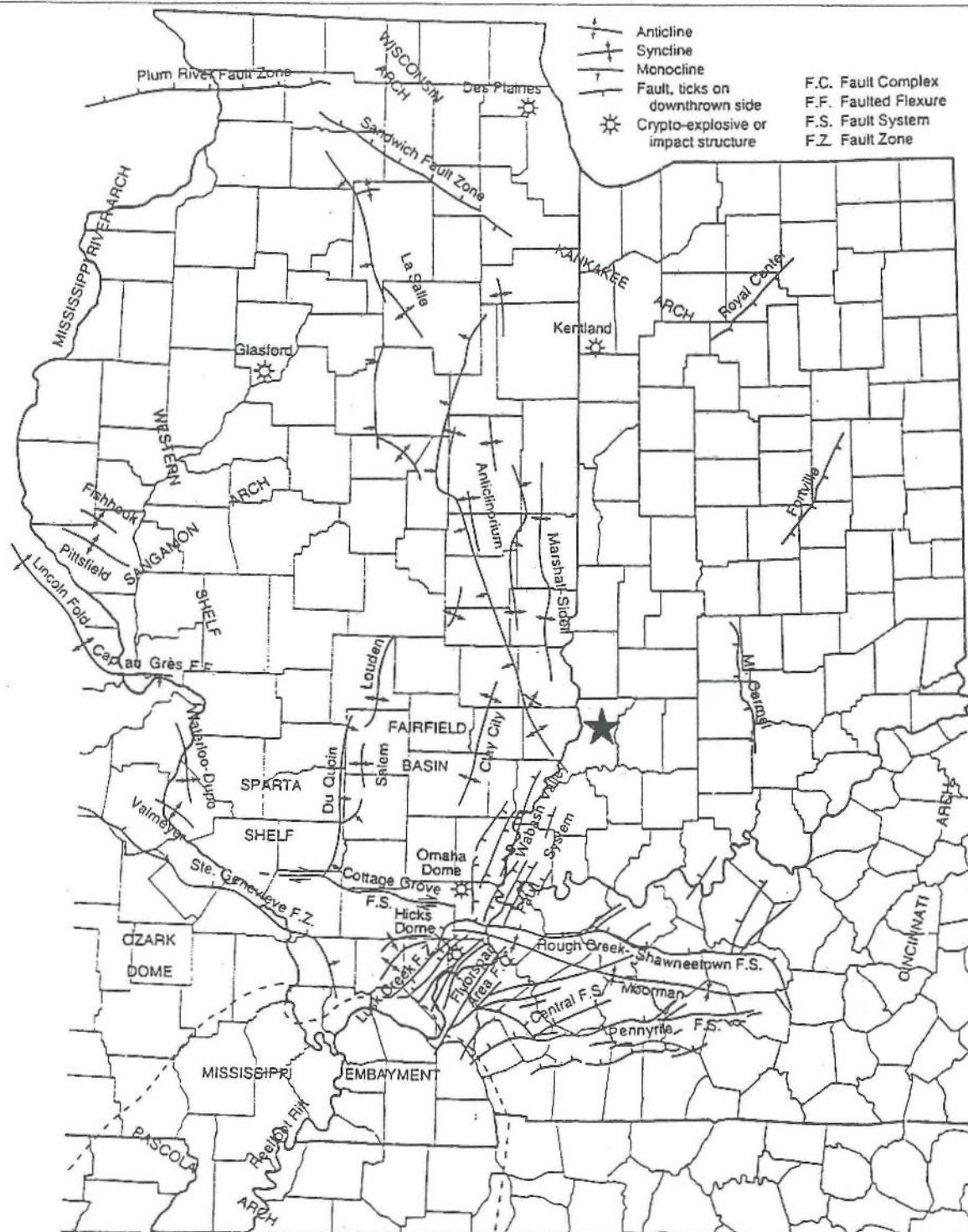
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.1-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

GEOLOGIC STRUCTURE OF THE EASTERN INTERIOR

DATE: 5/16/97	CHECKED BY: <i>FWL</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>JMS</i>	DWG. NO:



SITE LOCATION

N



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.1-4
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAJOR STRUCTURAL FEATURES
IN ILLINOIS AND NEIGHBORING STATES

DATE: 5/16/97	CHECKED BY: <i>FWW</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>IMS</i>	DWG. NO:



SITE LOCATION

N



ENVIROCORP

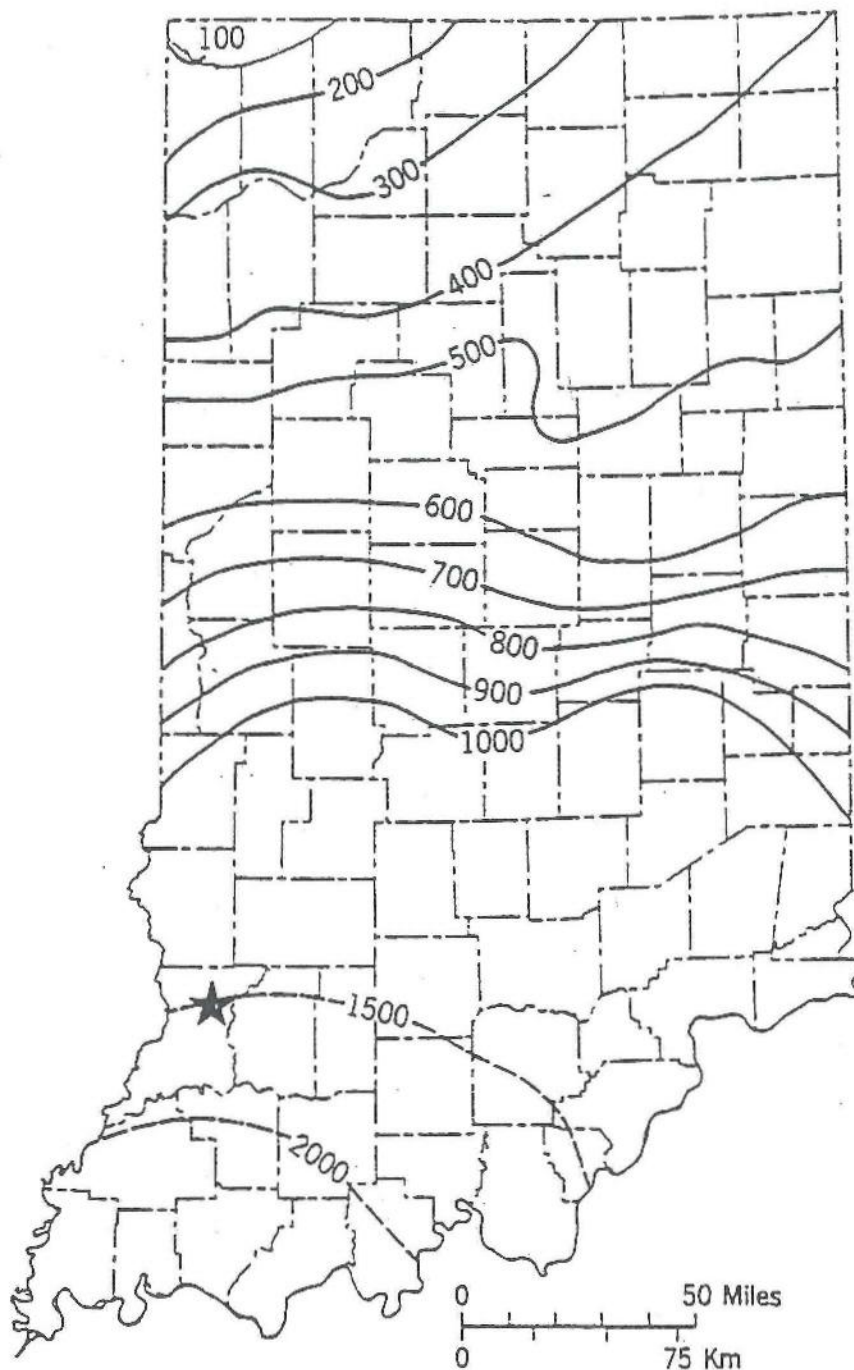
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.2-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE THICKNESS
OF THE POTSDAM SUPERGROUP IN INDIANA

DATE: 5/16/97	CHECKED BY: DWV	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: MS	DWG. NO:



★ SITE LOCATION



ENVIROCORP®

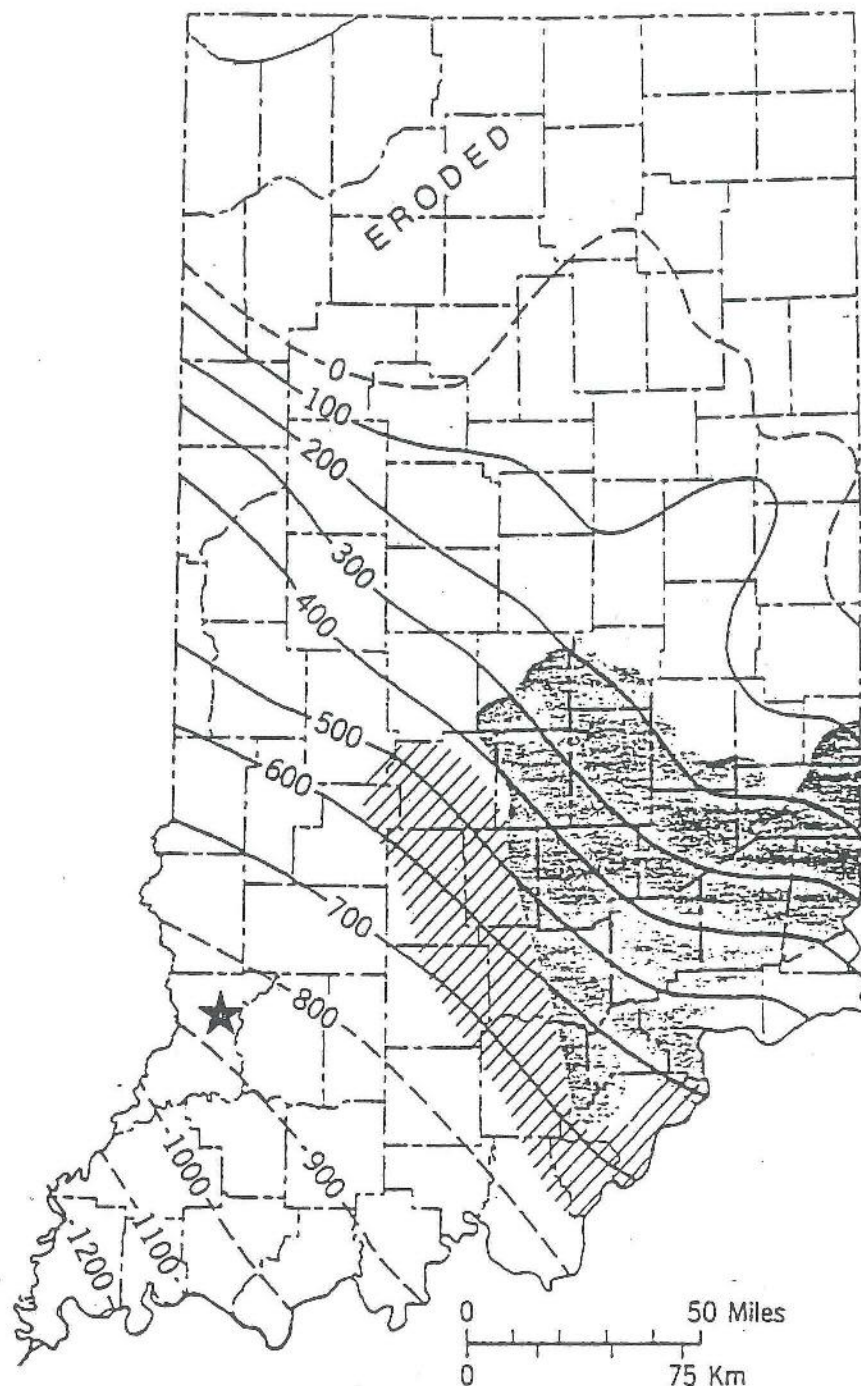
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.2-4
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE THICKNESS
OF THE POTOSI DOLOMITE IN INDIANA

DATE: 5/16/97	CHECKED BY: BWV	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: WKS	DWG. NO:



SITE LOCATION

N



ENVIROCORP

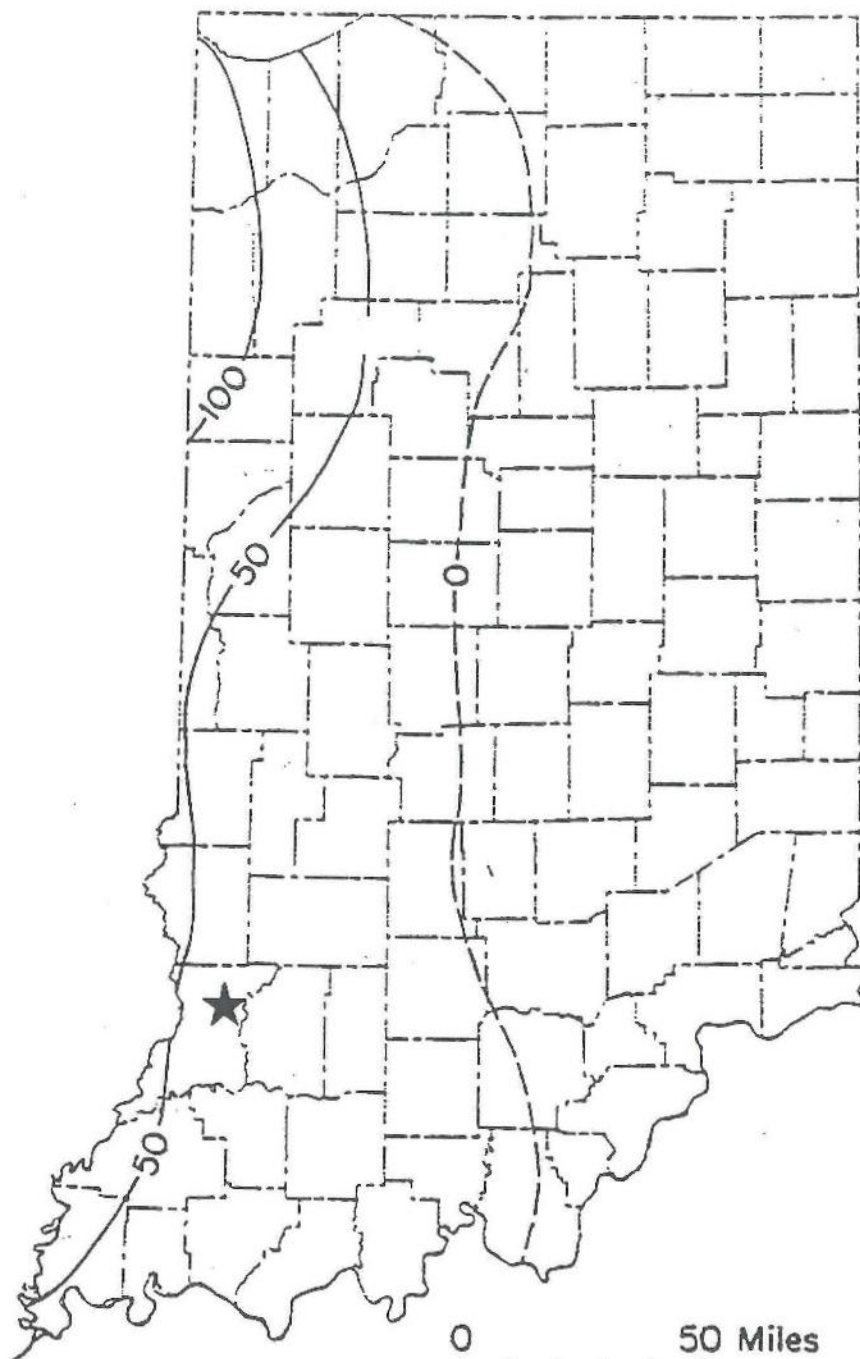
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.3-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE THICKNESS
OF THE SHAKOPEE DOLOMITE IN INDIANA

DATE: 5/16/97	CHECKED BY: <i>gww</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>MS</i>	DWG. NO:



SITE LOCATION



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.3-4
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE THICKNESS AND DISTRIBUTION
OF THE ST. PETER SANDSTONE IN INDIANA

DATE: 5/16/97	CHECKED BY: BWW	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: IMS	DWG. NO:



SITE LOCATION



ENVIROCORP

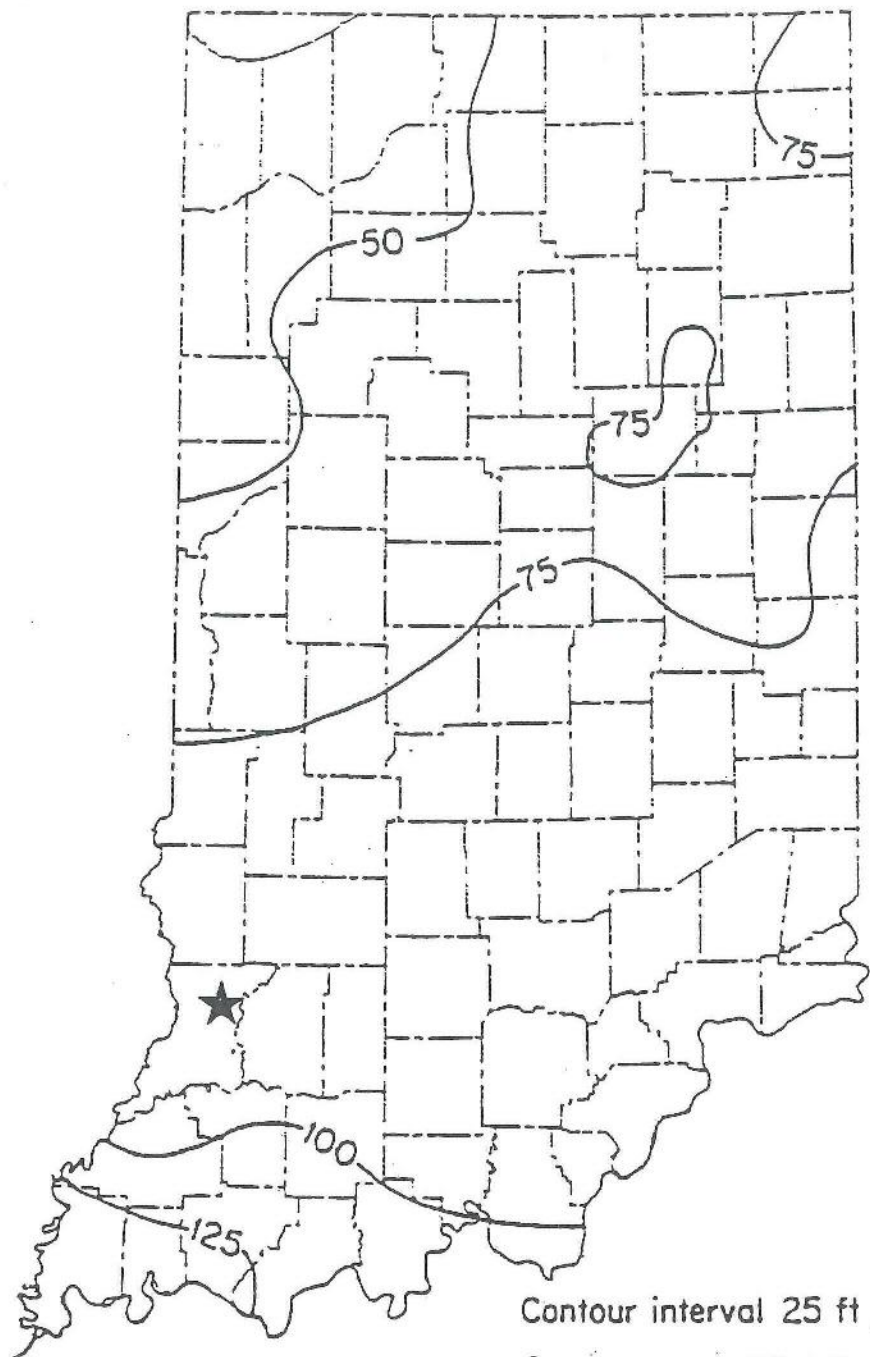
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.3-6
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE THICKNESS AND DISTRIBUTION
OF THE JOACHIM DOLOMITE IN INDIANA

DATE: 5/16/97	CHECKED BY: <i>BW</i>	JOB NO: 30A427B
DRAWN BY: CRB	APPROVED BY: <i>JMS</i>	DWG. NO:



Contour interval 25 ft

0 50 Miles
0 75 Km



SITE LOCATION

N



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.3-8

SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE THICKNESS AND DISTRIBUTION
OF THE PECATONICA FORMATION IN INDIANA

DATE: 5/16/97	CHECKED BY: <i>B. J. W.</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>IMS</i>	DWG. NO:

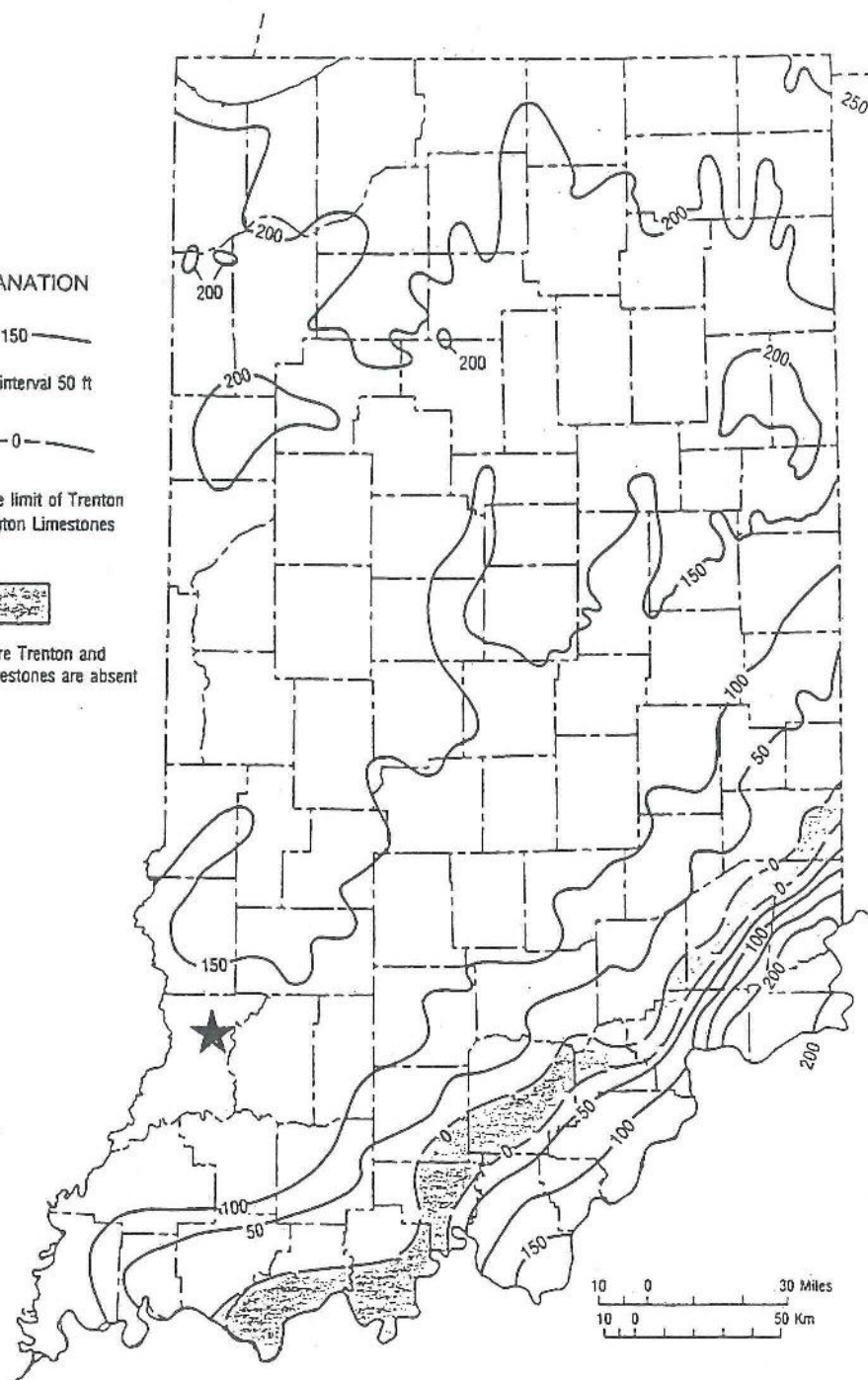
EXPLANATION

150
Contour interval 50 ft

0

Approximate limit of Trenton and Lexington Limestones

Area where Trenton and Lexington Limestones are absent



SITE LOCATION



ENVIROCORP

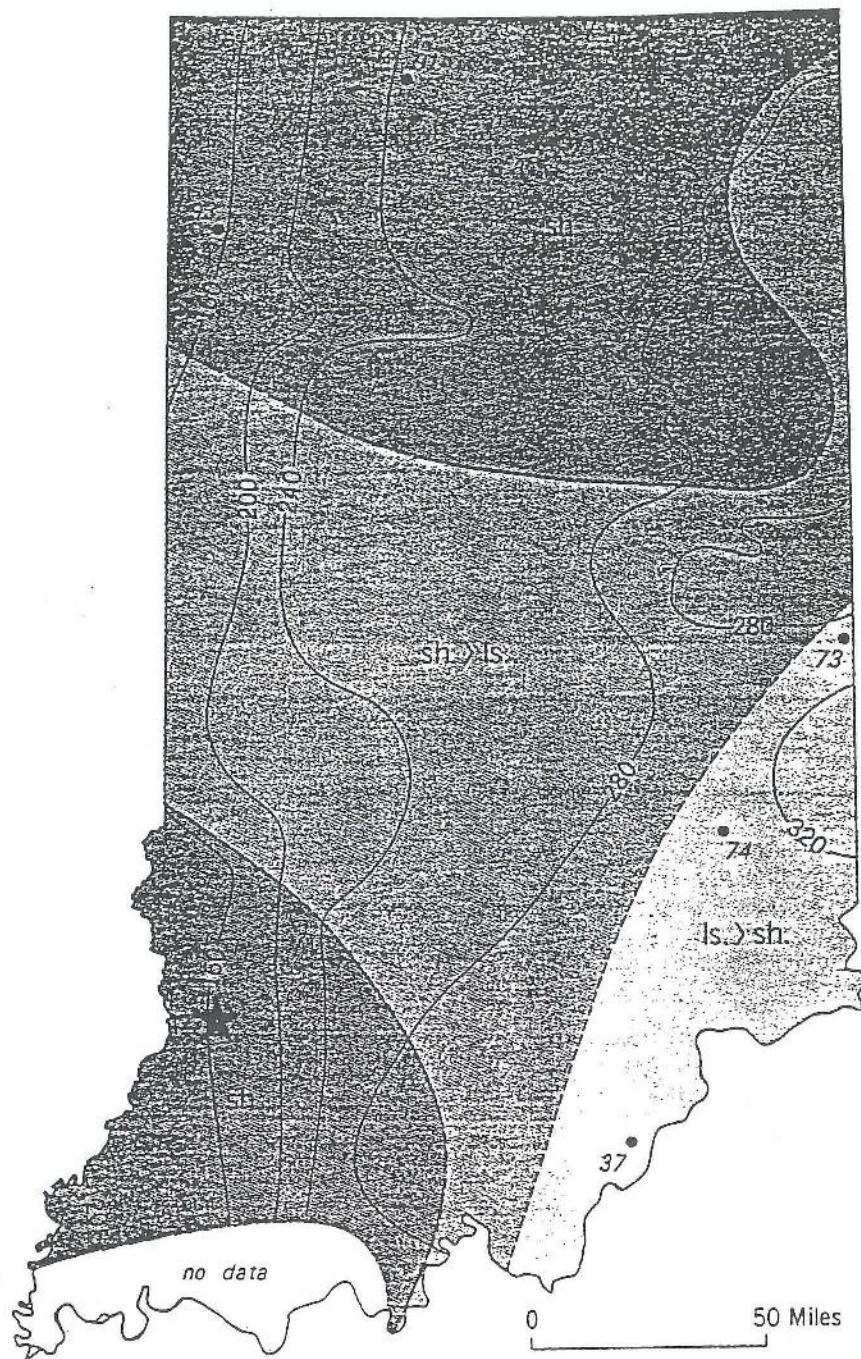
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.3-10
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE THICKNESS AND DISTRIBUTION
OF THE TRENTON AND LEXINGTON LIMESTONE IN INDIANA

DATE: 5/16/97	CHECKED BY: BWM	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: MS	DWG. NO:



SITE LOCATION



ENVIROCORP®

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.3-12
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THICKNESS AND LITHOFACIES
INTERPRETATIONS OF UNIT B, MAQUOKETA GROUP

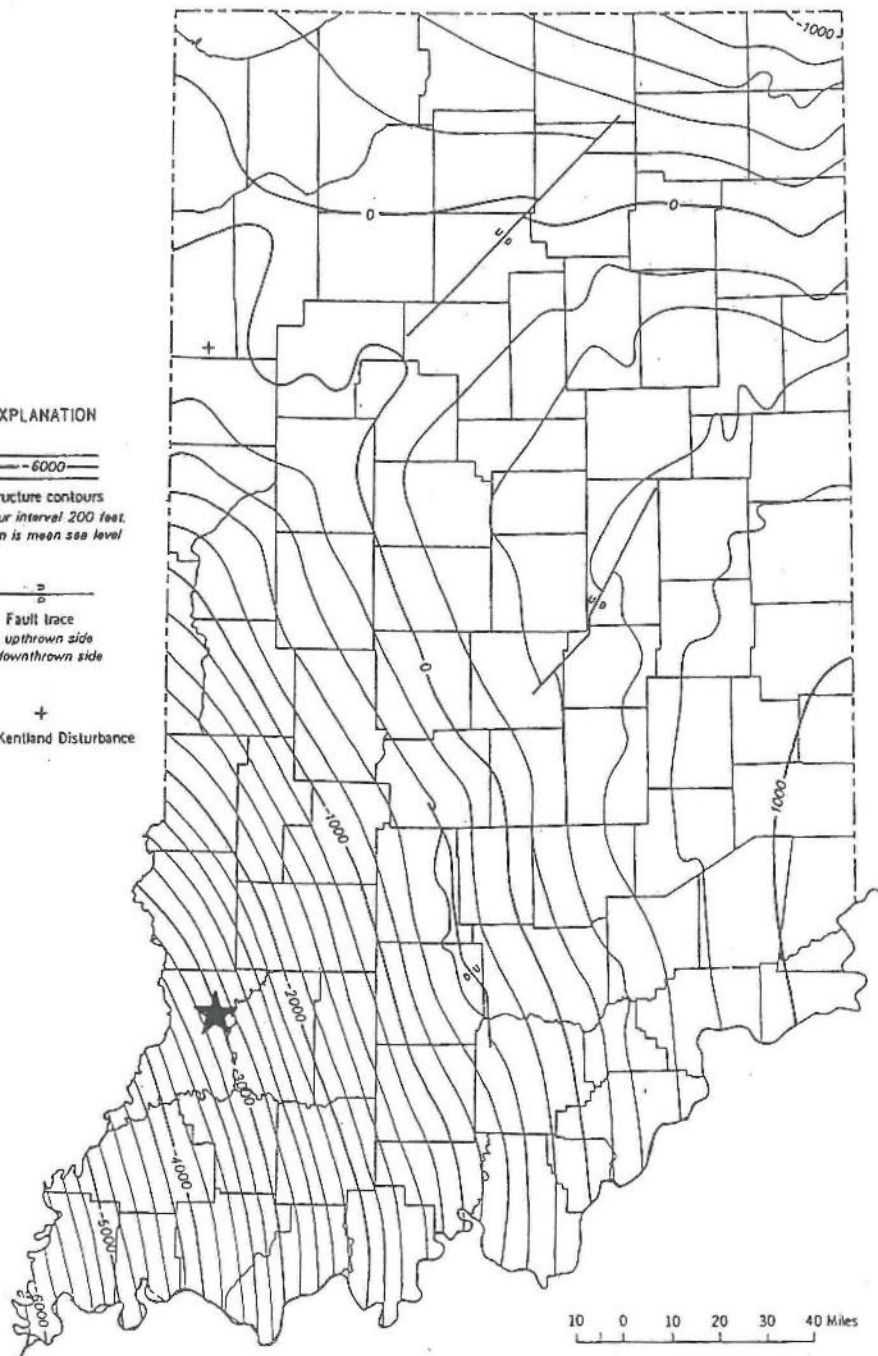
DATE: 5/16/97	CHECKED BY: <i>BWW</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>IMS</i>	DWG. NO:

EXPLANATION

— 6000 —
 Structure contours
 Contour interval 200 feet.
 Datum is mean sea level

— — —
 Fault trace
 U, upthrown side
 D, downthrown side

+
 Area of Kentland Disturbance



SITE LOCATION

N



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
 SOUTH BEND, IN.
 BATON ROUGE, LA.

FIGURE 3.2.3-14
SCEPTER INDUSTRIES, INC.
 BICKNELL, INDIANA

MAP OF INDIANA SHOWING STRUCTURAL
 CONFIGURATION ON TOP OF THE MAQUOKETA GROUP

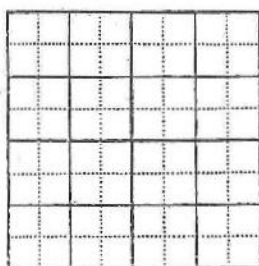
DATE: 5/16/97	CHECKED BY: BWW	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: JMS	DWG. NO:

DIVISION OF GEOLOGY

Indiana Department of Conservation

F Mont & Bessie Freeland (H&W) No. 1
Company The Nation Oil Co.
Permit No. 8965 T.D. 1816 P.B.T.D.
Elev. 493.4' I.P. D&A
Samples Req. Sample No.

casing	
size	depth



Rotary X Cable NL SL 330'
Shot Record EL WL 334'

Acid Record

Pressures

icing horizons, depths

Remarks: (Oil shows, d.s.t., p.b., casing perf.)
D.st. 1360-84 (2 pack) 1 hr. - Rec. 25' mud -
BHP 450# - D.st. 1806-16 - 1 hr. - Rec. 210'
salty sulphur w. - SSO

REVIEW CHECKED BY D. NATION 1956

LOCATION: Don. 150-48-5'

2375' HILL, 1435' HILL

ELEVATION: 494 (Paulin)

Date	Activity
7/5/50	Spud
1/20/50	Completed

County Knox
Twp. 4N Rge. 8E
Sec. Don. 150
Loc. NW SW
Civil Twp. Vigo
Pool Wildcat X

Top	Driller or Sample	Elec.
W. Franklin ls.		
Prov. ls.		
Coal No.		
Penn. sd.		
Biehl		
Mansfield ss.		
Up. Kinkaid		
Lo. Kinkaid		
Degonia		
Clore		
Palestine		
Up. Menard		
Main Menard		
L. Menard		
Waltersburg		
"		
Vienna		
Tar Springs		
(Jett)		
Up. Glen Dean		1067-90
Main Glen Dean		
Hardinsburg		
(Jones)		
Golconda		1097-1102
Jackson		
Barlow (Beech Creek)		1128-40
Cypress		
"		
Pt. Creek		1159-82
Pt. Creek		
Bethel-Ben.		1201-69
"		
Up. Renault		1278-1307
Renault		
Aux Vases		
"		
"		
Ste. Gen.		1310
O'Hara-Rosiclare		1327-46
Fredonia		1372-78
McClosky		1391-1417
"		1434-56
"		
St. Louis		
Salem		1741
Carper		
Rockford		
New Albany		
Dev. ls.		
"		
"		
Silurian		
Ordovician		

Well No. 2

**Mont & B. Freeland (H & W) No. 1, The Nation Oil Co.
TD - 1816' (1950) (Don 149, T4N, R8W)
Permit No. 8965**

STATE OF INDIANA.

COUNTY OF

KNOX

WELL PLUGGING AFFIDAVIT

Permit No.

37865

Type of Bond—\$1,000

—\$5,000

Date Bond released

JUL 19 1979

DESIGNATION

Operator TEXJAP OIL & GAS CO.
 Form Name CLYDE WAMPLER.
 Well No. 1
 ELEVATION 526'

LOCATION

County KNOX Twp. 44 Rge. 8W
 Section 149 1/4 1/4 1/4
2400 FSWH from N line 990 FSWH from E line
 Civil Township WASHINGTON

Date Permit Issued	Has this well ever produced oil or gas	Character of well at completion (initial production):		
<u>7-14-78</u>	<u>NO</u>	Oil (bbls/day)	Gas (MCF/day)	Dry?
Date plugged:	Total depth	Amount well producing when plugged:		
<u>8-13-78</u>	<u>2170'</u>	Oil (bbls/day)	Gas (MCF/day)	Water (bbls./day)
		<u>NOAK</u>		

Date drilling began 8-5-78 Date drilling completed 8-11-78 Kind of drilling tools used ROTARY

DETAILS OF PLUGGING:

Filled with MUD From 2170' To 450'
 (Rotary Mud, Cement, or Other Materials)
 Kind of Plug CEMENT From 450' To 250'
 Filled with WATER WASH From 250' To 0'
 Kind of Plug From To feet
 Filled with From To feet
 Kind of Plug From To feet
 Filled with From To feet
 Kind of Plug From To feet

IF WORKABLE COAL BEDS WERE ENCOUNTERED IN THIS HOLE, DESCRIBE THE METHOD EMPLOYED TO PROTECT SAME. (A workable coal bed is 24 inches or more in thickness above 1,200 feet in depth.) CEMENTED

- (1) Have pits, cellar and other excavations been filled? Yes ☒ No ☐
 (2) Have equipment, concrete bases and debris been removed? Yes ☒ No ☐
 (3) Has surface casing been cut off below plow depth? Yes ☒ No ☐
 (4) Has well-site been levelled? Yes ☒ No ☐

CASING RECORD

PUT IN WELL		PULLED OUT		LEFT IN WELL		Remarks
Size	Feet	Feet	Inches	Feet	Inches	
7"	831					



TEXJAP OIL & GAS CO.

(Signature of person, firm or corporation having custody or control of well.)

X Per C. H. Majors
 Address 2324 FREDRICK ST OAKS, KY 42301
Frank Utley
 (Signature and title of party supervising plugging of well.)
 Address RR4, Princeton, KY 42367
 Subscribed and sworn to before me this 13 day of August A. D. 19 78
 My commission expires 6-24-80
Ethel Utley
 Notary Public

LOCATION: Don. 149-4N-8W
2400' SWL, 990' SEL
ELEVATION: 527 (Paulin)

STATE OF INDIANA
Division of Oil and Gas
606 State Office Building
Indianapolis, Indiana 46204

API # 13 083-20513

WELL COMPLETION OR RECOMPLETION REPORT AND WELL LOG

TO BE FILED IMMEDIATELY AFTER COMPLETION OF WELL.
NOTICE: IT IS NECESSARY TO SUBMIT A RECORD FOR EACH PERMIT.

DESIGNATION

Operator Tenjab Oil & Gas Co.
Farm Name Clyde Wampler #1
Well No. #1

PERMIT NO. 37865

TYPE OF WELL

New Well ☒ Workover ☐ Deepening ☐

LOCATION

County Knox Co. Twp. 4N Rge. 8W
Section 149 $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$
2400 SWL from N line 990 SEL from E line
S W

ELEVATION 527

TOTAL DEPTH

Driller's Log 2170 Electric Log ☐

OPERATIONAL DATES

Commenced 8/2/78 Completed 8/13/78

TOOLS

Rotary (interval) 0-2170 Cable (interval) ☐

TYPE OF COMPLETION

Dry Hole ☒ Stratigraphic Test ☐
Oil ☐ Saltwater Disposal ☐
Gas ☐ Water Supply ☐
Pressure Maintenance or
Secondary Recovery: Gas Storage: ☐
Water Injection ☐ Injection - Extraction ☐
Gas Injection ☐ Observation ☐

INITIAL PRODUCTION

Oil ☐ Gas ☐

COMPLETION INTERVAL

Interval(s) ☐

Formation Name(s) ☐

WELL TREATMENT

Shot ☐ qts. ☐ interval
Shot ☐ qts. ☐ interval
Acid ☐ gals. ☐ interval
Acid ☐ gals. ☐ interval
Fracture ☐ gals. ☐ interval
Fracture ☐ gals. ☐ interval

CASING RECORD

Size	Depth	Sks. Cement	Csg Pulled
<u>7 7/8</u>	<u>308</u>	<u>200</u>	<u>none</u>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

OCCURRENCE OF OIL AND GAS

Interval	Type of Formation (ls., ss., etc.)	Remarks (fill-up, tests, etc.)
<u>1815-1830</u>	<u>Limestone</u>	<u>Odor & SO DST - open 2 hours</u>
<input type="checkbox"/>	<input type="checkbox"/>	<u>Rec. 10' mud</u>
<input type="checkbox"/>	<input type="checkbox"/>	<u>30min. IBHP 684 PSI</u>
<input type="checkbox"/>	<input type="checkbox"/>	<u>30min. FBHP 603 PSI</u>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The above information is complete and correct.

Signed James A. Buda

Title Partner

Address of Operator 2334 Fidelity Overlook, Ky 42301

GIVE COMPLETE FORMATION RECORD ON REVERSE SIDE

Well No. 1

**Clyde Wampler No. 1, Tenjab Oil & Gas Co.
TD - 2170' (1978) (Don 149, T4N, R8W)
Permit No. 37865**

ATTACHMENT B

**WELL RECORDS AND PLUGGING REPORTS FOR WELLS
DEEPER THAN 750 FEET LOCATED WITHIN THE TWO MILE
AREA OF REVIEW**

**Subpart B—Criteria and Standards
Applicable to Class I Wells**

**§ 146.11 Criteria and standards applicable
to Class I nonhazardous wells.**

This subpart establishes criteria and standards for underground injection control programs to regulate Class I nonhazardous wells.

[53 FR 28148, July 26, 1988]

§ 146.12 Construction requirements.

(a) All Class I wells shall be sited in such a fashion that they inject into a formation which is beneath the lowermost formation containing, within one quarter mile of the well bore, an underground source of drinking water.

(b) All Class I wells shall be cased and cemented to prevent the movement of fluids into or between underground sources of drinking water. The casing and cement used in the construction of each newly drilled well shall be designed for the life expectancy of the well. In determining and specifying casing and cementing requirements, the following factors shall be considered:

- (1) Depth to the injection zone;
- (2) Injection pressure, external pressure, internal pressure, and axial loading;
- (3) Hole size;
- (4) Size and grade of all casing strings (wall thickness, diameter, nominal weight, length, joint specification, and construction material);
- (5) Corrosiveness of injected fluid, formation fluids, and temperatures;
- (6) Lithology of injection and confining intervals; and
- (7) Type or grade of cement.

(c) All Class I injection wells, except those municipal wells injecting non-corrosive wastes, shall inject fluids through tubing with a packer set immediately above the injection zone, or tubing with an approved fluid seal as an alternative. The tubing, packer, and fluid seal shall be designed for the expected service.

(1) The use of other alternatives to a packer may be allowed with the written approval of the Director. To obtain approval, the operator shall submit a written request to the Director, which shall set forth the proposed

alternative and all technical data supporting its use. The Director shall approve the request if the alternative method will reliably provide a comparable level of protection to underground sources of drinking water. The Director may approve an alternative method solely for an individual well or for general use.

(2) In determining and specifying requirements for tubing, packer, or alternatives the following factors shall be considered:

- (i) Depth of setting;
- (ii) Characteristics of injection fluid (chemical content, corrosiveness, and density);
- (iii) Injection pressure;
- (iv) Annular pressure;
- (v) Rate, temperature and volume of injected fluid; and
- (vi) Size of casing.

(d) Appropriate logs and other tests shall be conducted during the drilling and construction of new Class I wells. A descriptive report interpreting the results of such logs and tests shall be prepared by a knowledgeable log analyst and submitted to the Director. At a minimum, such logs and tests shall include:

(1) Deviation checks on all holes constructed by first drilling a pilot hole, and then enlarging the pilot hole by reaming or another method. Such checks shall be at sufficiently frequent intervals to assure that vertical avenues for fluid migration in the form of diverging holes are not created during drilling.

(2) Such other logs and tests as may be needed after taking into account the availability of similar data in the area of the drilling site, the construction plan, and the need for additional information, that may arise from time to time as the construction of the well progresses. In determining which logs and tests shall be required, the following logs shall be considered for use in the following situations:

(i) For surface casing intended to protect underground sources of drinking water:

(A) Resistivity, spontaneous potential, and caliper logs before the casing is installed; and

Environmental Protection Agency

(B) A cement bond, temperature, or density log after the casing is set and cemented.

(ii) For intermediate and long strings of casing intended to facilitate injection:

(A) Resistivity, spontaneous potential, porosity, and gamma ray logs before the casing is installed;

(B) Fracture finder logs; and

(C) A cement bond, temperature, or density log after the casing is set and cemented.

(e) At a minimum, the following information concerning the injection formation shall be determined or calculated for new Class I wells:

- (1) Fluid pressure;
- (2) Temperature;
- (3) Fracture pressure;
- (4) Other physical and chemical characteristics of the injection matrix; and
- (5) Physical and chemical characteristics of the formation fluids.

[45 FR 42500, June 24, 1980, as amended at 46 FR 43162, Aug. 27, 1981]

§ 146.13 Operating, monitoring and reporting requirements.

(a) *Operating requirements.* Operating requirements shall, at a minimum, specify that:

(1) Except during stimulation injection pressure at the wellhead shall not exceed a maximum which shall be calculated so as to assure that the pressure in the injection zone during injection does not initiate new fractures or propagate existing fractures in the injection zone. In no case shall injection pressure initiate fractures in the confining zone or cause the movement of injection or formation fluids into an underground source of drinking water.

(2) Injection between the outermost casing protecting underground sources of drinking water and the well bore is prohibited.

(3) Unless an alternative to a packer has been approved under § 146.12(c), the annulus between the tubing and the long string of casings shall be filled with a fluid approved by the Director and a pressure, also approved by the Director, shall be maintained on the annulus.

(b) *Monitoring requirements.* Monitoring requirements shall, at a minimum, include:

(1) The analysis of the injected fluids with sufficient frequency to yield representative data of their characteristics;

(2) Installation and use of continuous recording devices to monitor injection pressure, flow rate and volume, and the pressure on the annulus between the tubing and the long string of casing;

(3) A demonstration of mechanical integrity pursuant to § 146.8 at least once every five years during the life of the well; and

(4) The type, number and location of wells within the area of review to be used to monitor any migration of fluids into and pressure in the underground sources of drinking water, the parameters to be measured and the frequency of monitoring.

(c) *Reporting requirements.* Reporting requirements shall, at a minimum, include:

(1) Quarterly reports to the Director on:

(i) The physical, chemical and other relevant characteristics of injection fluids;

(ii) Monthly average, maximum and minimum values for injection pressure, flow rate and volume, and annular pressure; and

(iii) The results of monitoring prescribed under paragraph (b)(4) of this section.

(2) Reporting the results, with the first quarterly report after the completion, of:

(i) Periodic tests of mechanical integrity;

(ii) Any other test of the injection well conducted by the permittee if required by the Director; and

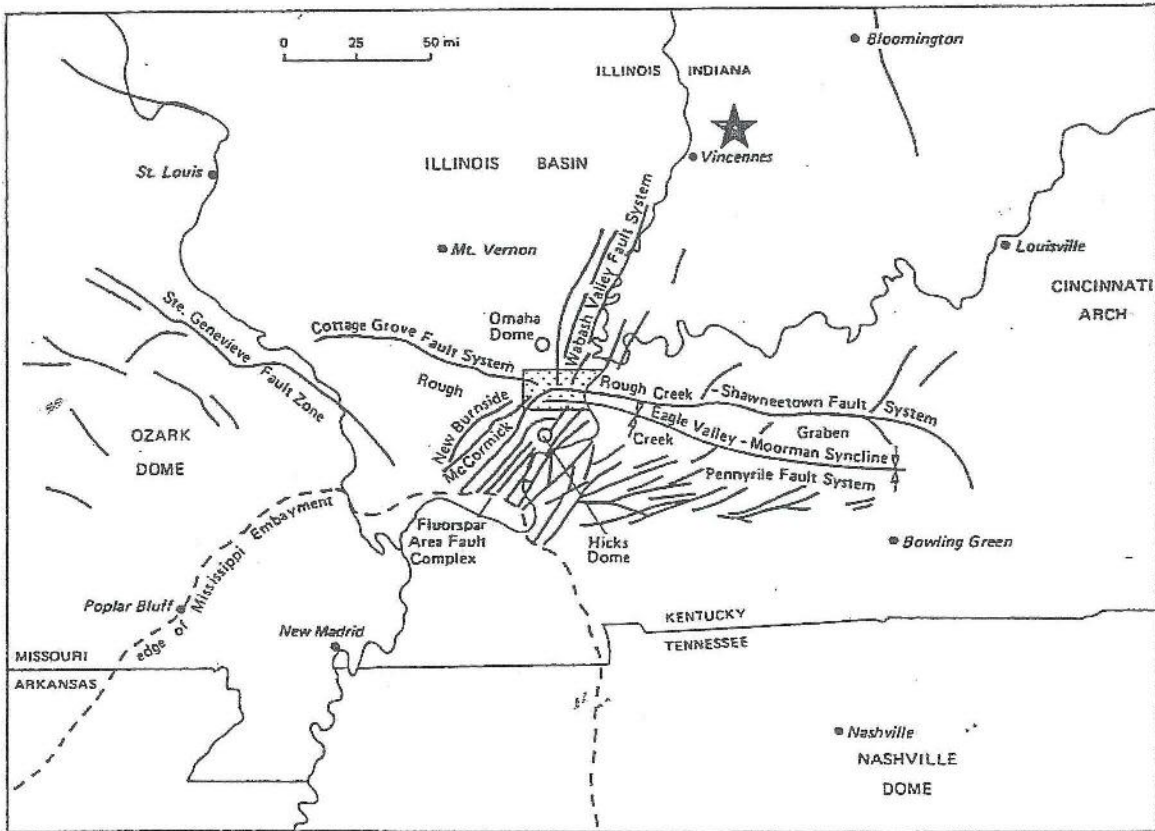
(iii) Any well work over.

(d) *Ambient monitoring.* (1) Based on a site-specific assessment of the potential for fluid movement from the well or injection zone and on the potential value of monitoring wells to detect such movement, the Director shall require the owner or operator to develop a monitoring program. At a minimum, the Director shall require monitoring of the pressure buildup in the injection zone annually, including

ATTACHMENT A

**MINIMUM CRITERIA FOR SITING
OF A CLASS I WASTE INJECTION WELL**

DRAWING



ISGS 1584



SITE LOCATION

N



ENVIROCORP

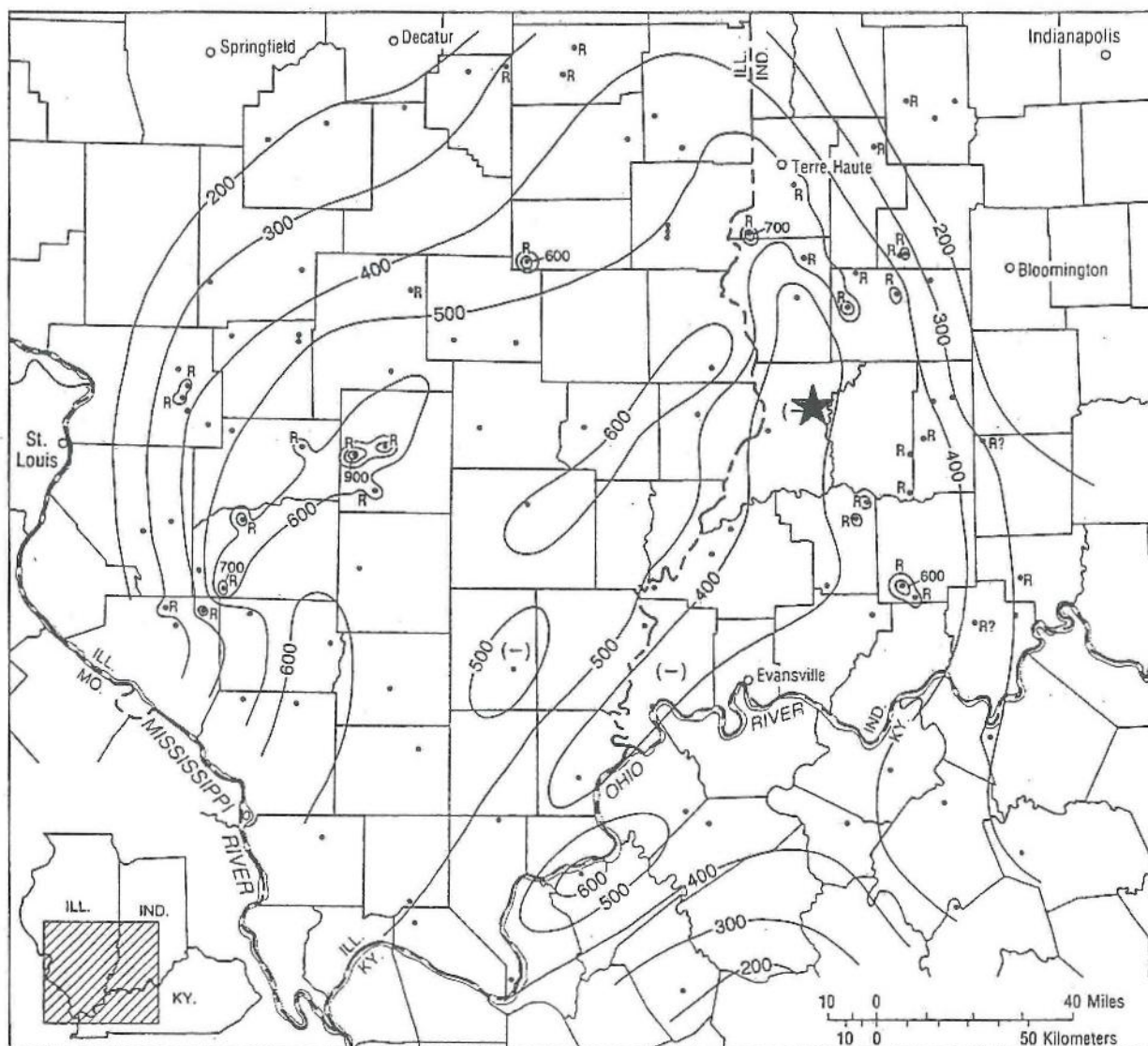
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.4-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP OF REGIONAL TECTONIC SETTING ILLUSTRATING
LOCATION OF WABASH VALLEY FAULT SYSTEM

DATE: 5/16/97	CHECKED BY: <i>BWN</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>IMS</i>	DWG. NO:



R INDICATES WELLS THAT PENETRATE REEFS AND THAT MAY YIELD THICKNESSES GREATER THAN REGIONAL THICKNESSES. CONTOUR INTERVAL IS 100 FEET.

★ SITE LOCATION



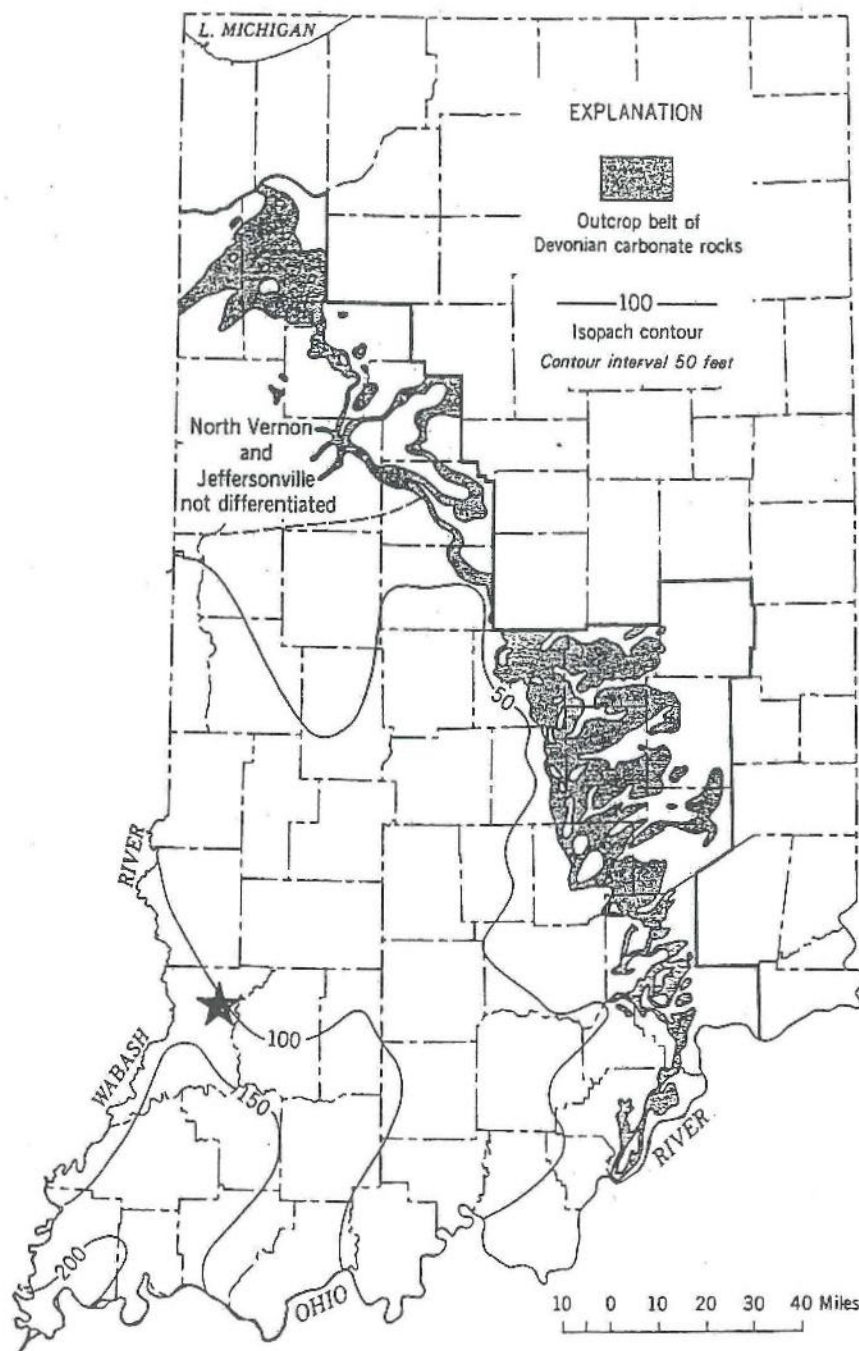
ENVIROCORP
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.4-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THICKNESS OF THE MOCCASIN SPRINGS FORMATION AND THE BAILEY LIMESTONE

DATE: 5/16/97	CHECKED BY: <i>BUM</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>JMS</i>	DWG. NO:



SITE LOCATION



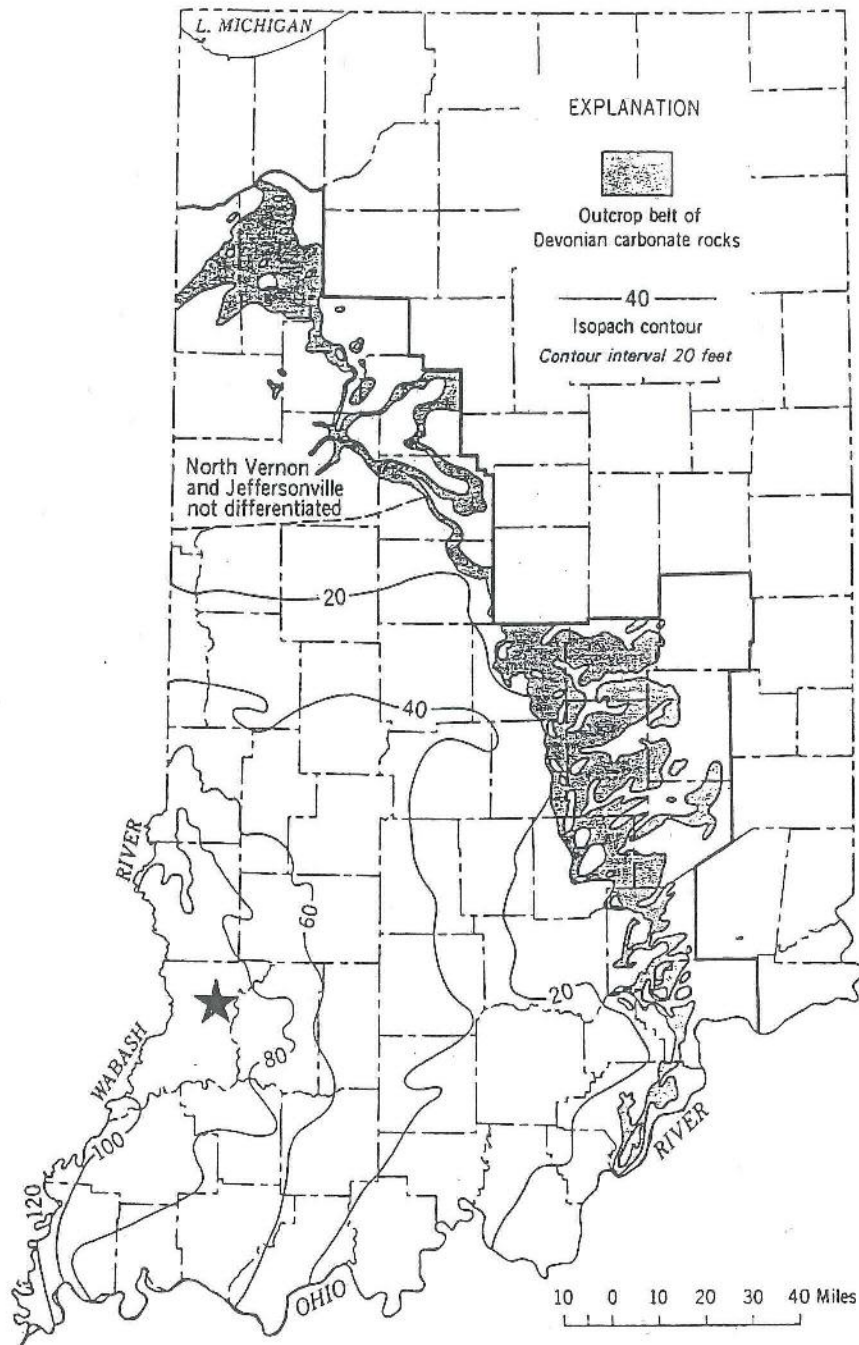
ENVIROCORP®

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.5-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP SHOWING THICKNESS
OF JEFFERSONVILLE LIMESTONE

DATE: 5/16/97	CHECKED BY: BMM	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: JMS	DWG. NO:



SITE LOCATION

N



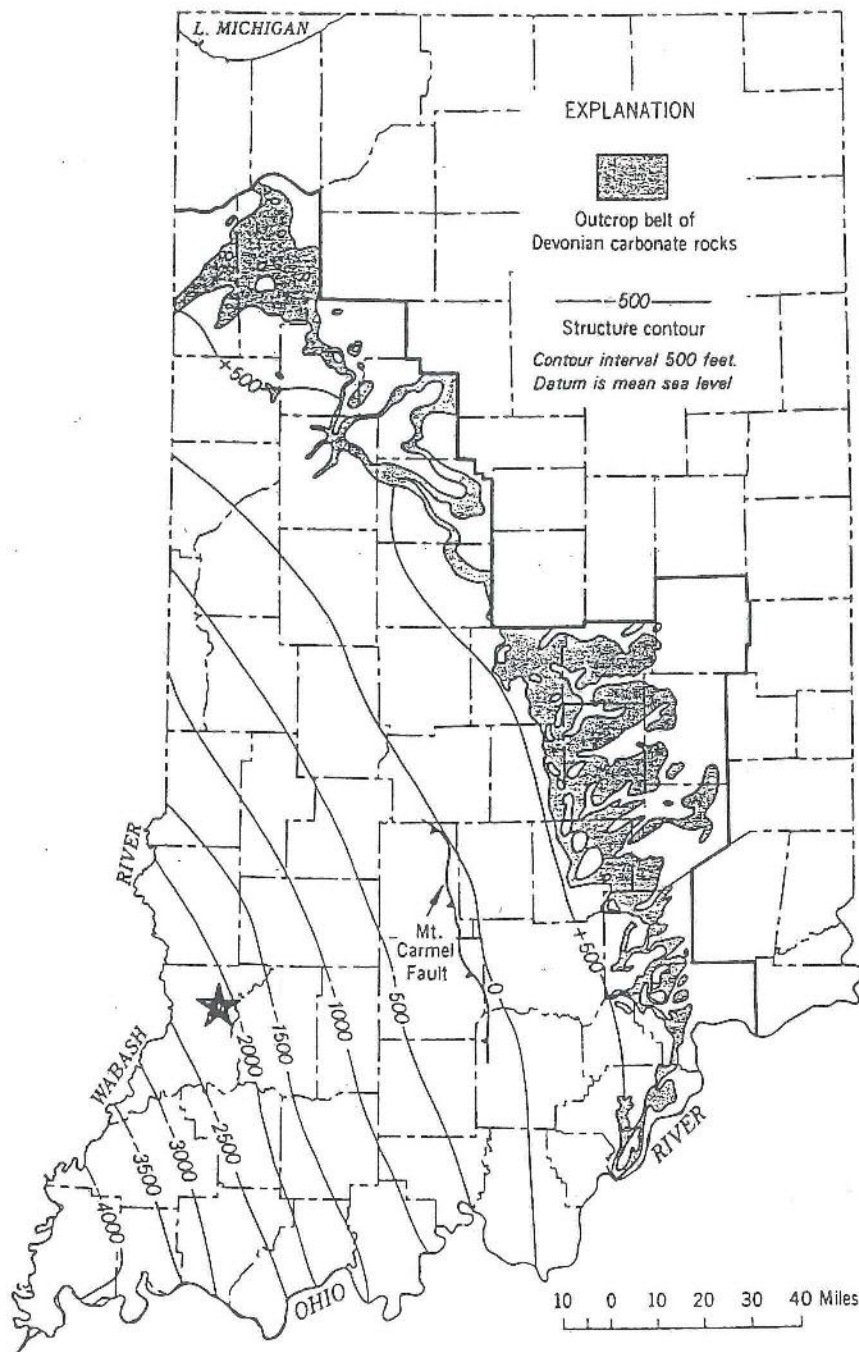
ENVIROCORP®

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.5-4
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP SHOWING THICKNESS
OF NORTH VERNON LIMESTONE

DATE: 5/16/97	CHECKED BY: <i>FWM</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>JMS</i>	DWG. NO:



SITE LOCATION



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.5-6
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP SHOWING STRUCTURE
ON BASE OF NEW ALBANY SHALE

DATE: 5/16/97	CHECKED BY: RUM	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: IMS	DWG. NO:

EXPLANATION

— 50 —

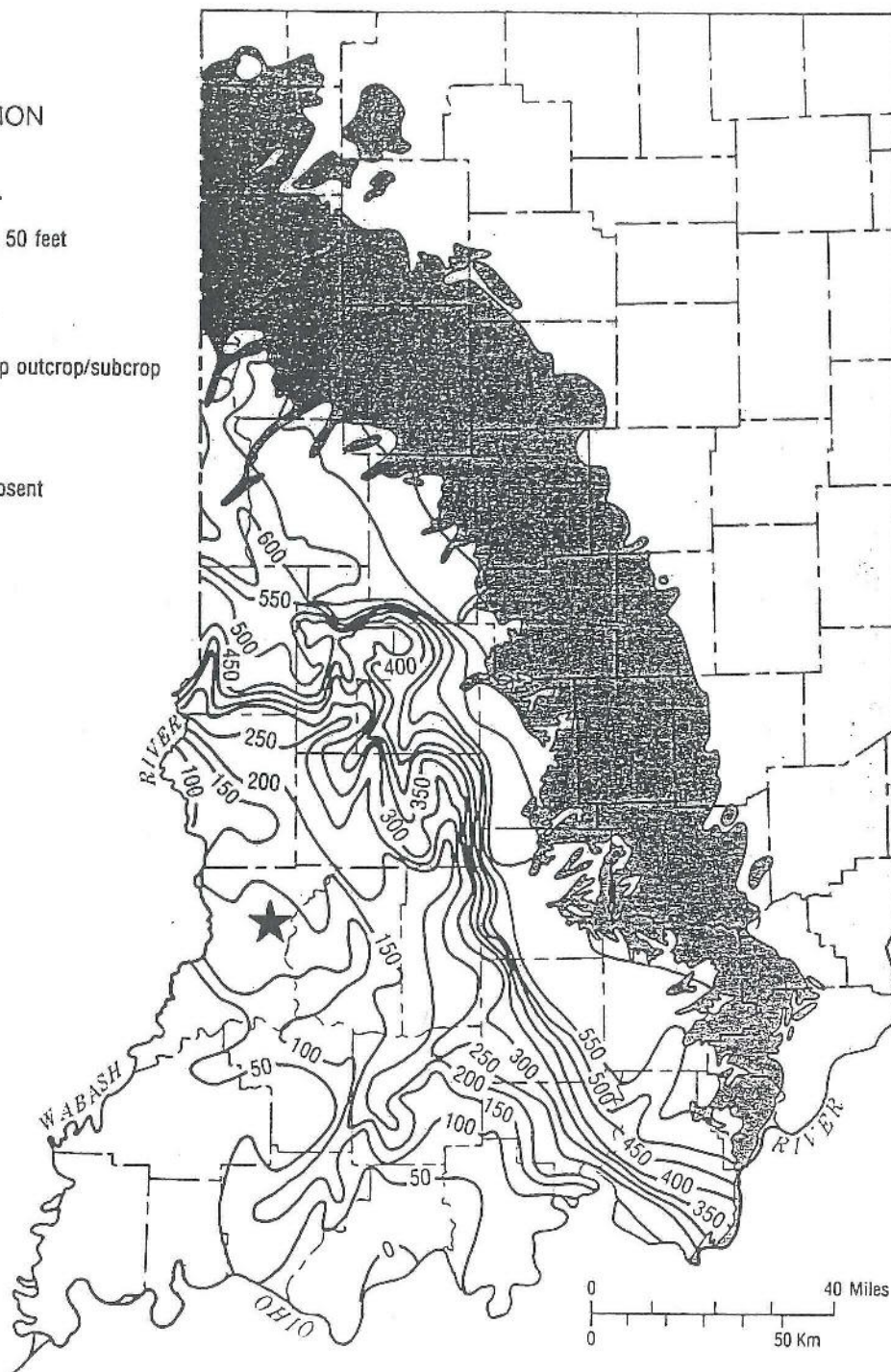
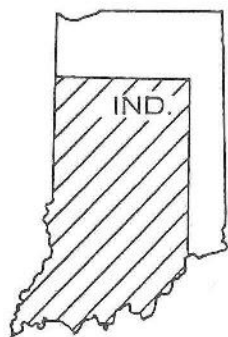
Contour Interval 50 feet



Area of the Borden Group outcrop/subcrop



Borden Group absent



SITE LOCATION

N

ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

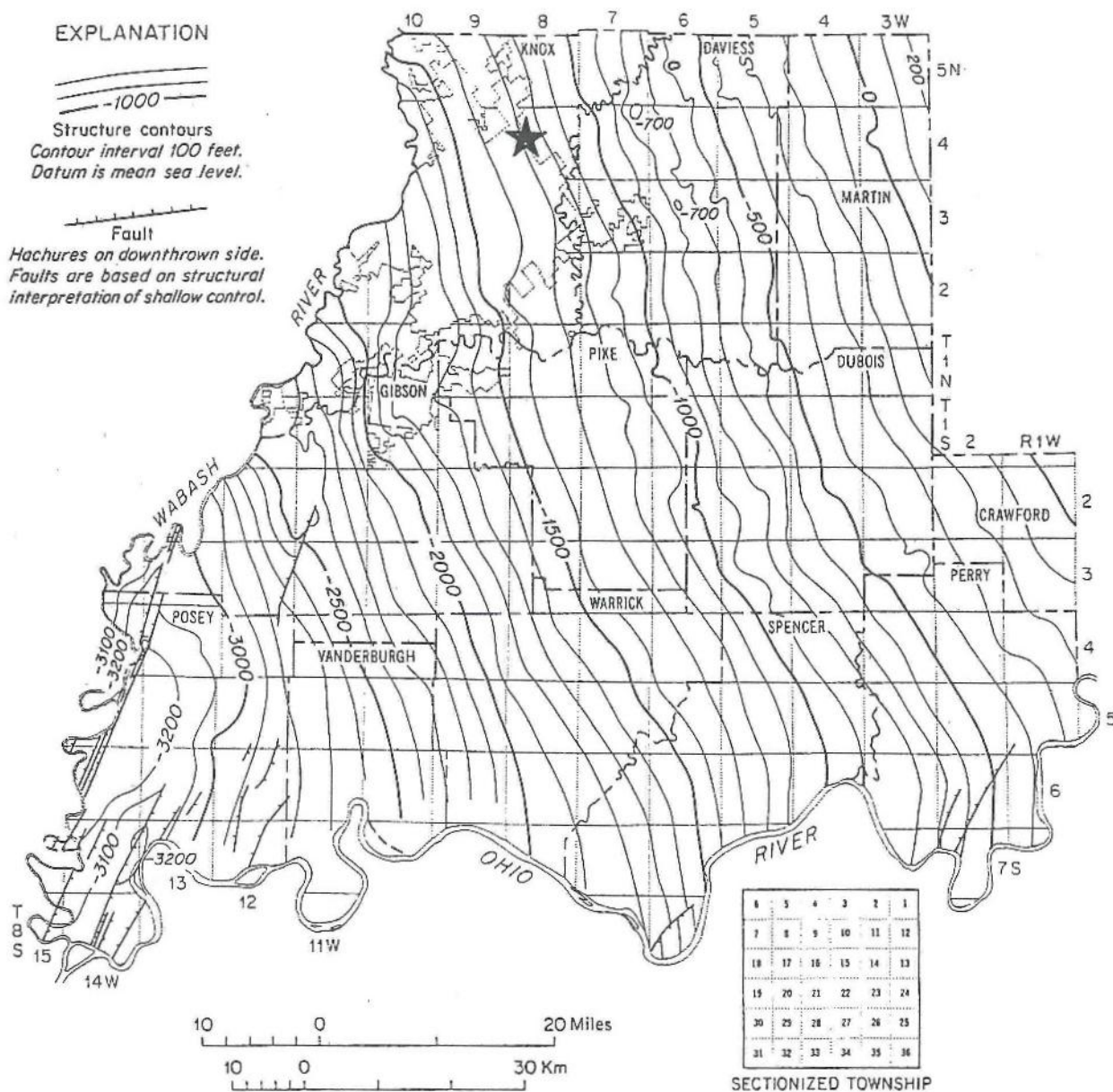
FIGURE 3.2.6-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP SHOWING THICKNESS
OF THE BORDEN GROUP

DATE: 5/16/97	CHECKED BY: <i>FWM</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>JMS</i>	DWG. NO:

EXPLANATION

Structure contours
Contour interval 100 feet.
Datum is mean sea level.

Fault
Hachures on downthrown side.
Faults are based on structural interpretation of shallow control.



SITE LOCATION

N



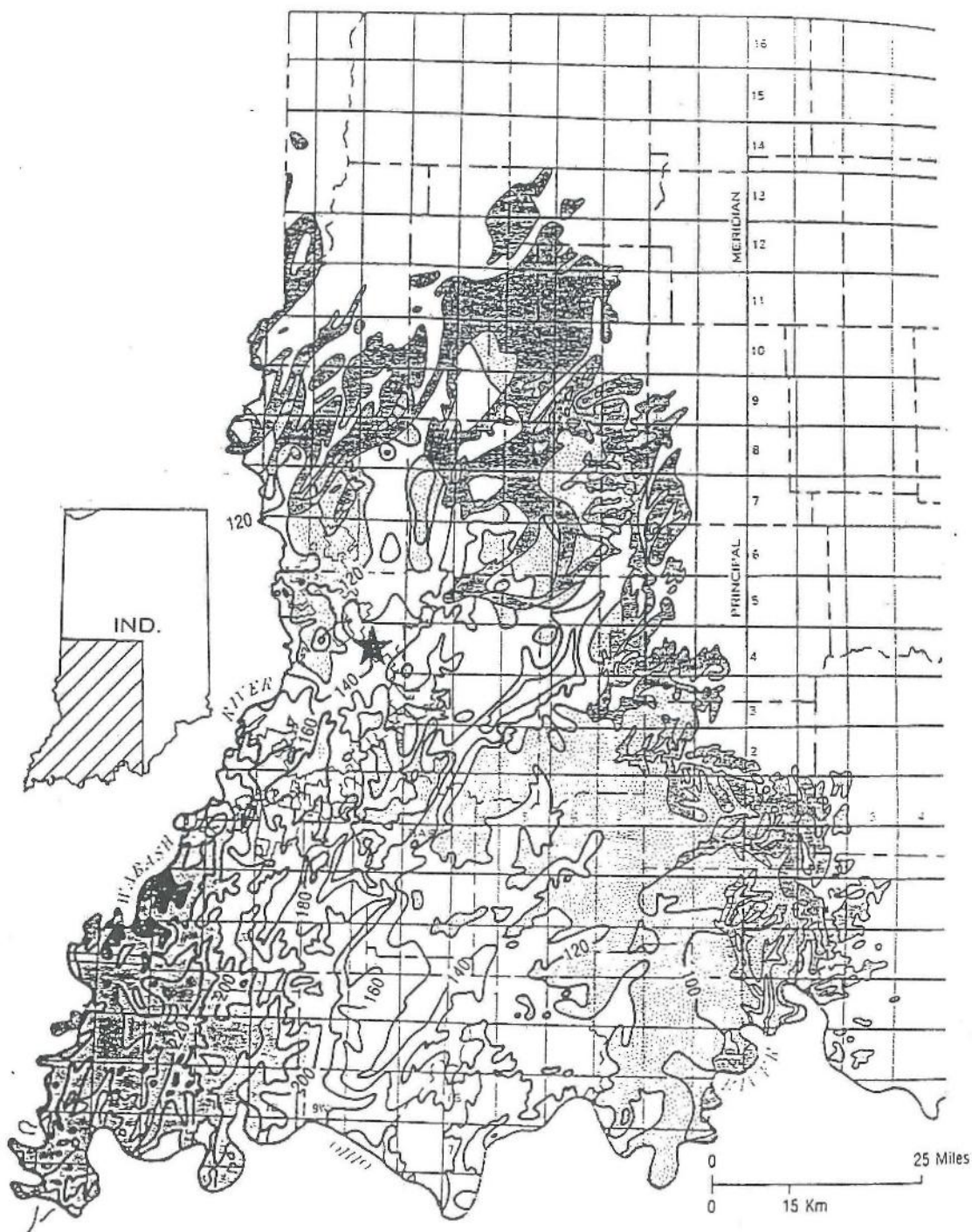
ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.6-4
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP SHOWING STRUCTURE ON TOP
OF THE SALEM LIMESTONE

DATE: 5/16/97 CHECKED BY: *RM* JOB NO: 30A4278
DRAWN BY: CRB APPROVED BY: *MS* DWG. NO:



SITE LOCATION

N



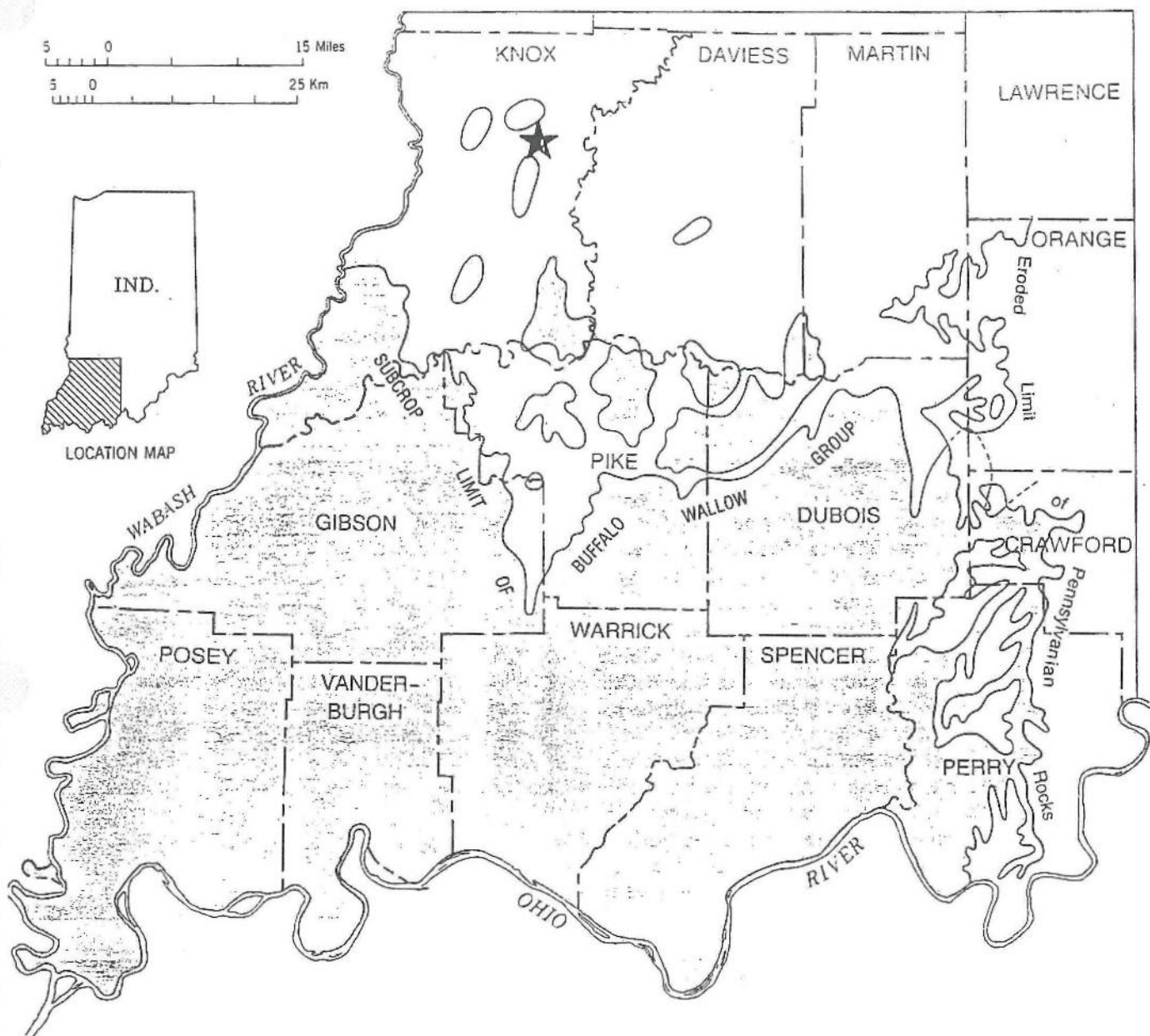
ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.6-6
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP SHOWING THICKNESS
OF THE WEST BADEN GROUP

DATE: 5/16/97 CHECKED BY: *gmm* JOB NO: 30A4278
DRAWN BY: CRB APPROVED BY: *JMS* DWG. NO:



SITE LOCATION

N



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.6-8
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP SHOWING THE ERODED LIMIT
OF THE PENNSYLVANIAN SYSTEM AND THE SUBCROP
LIMIT OF THE BUFFALO WALLOW GROUP

DATE: 5/16/97	CHECKED BY: <i>SW</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>MS</i>	DWG. NO:

EXPLANATION

—700—

Contour Interval 200 feet



Fault

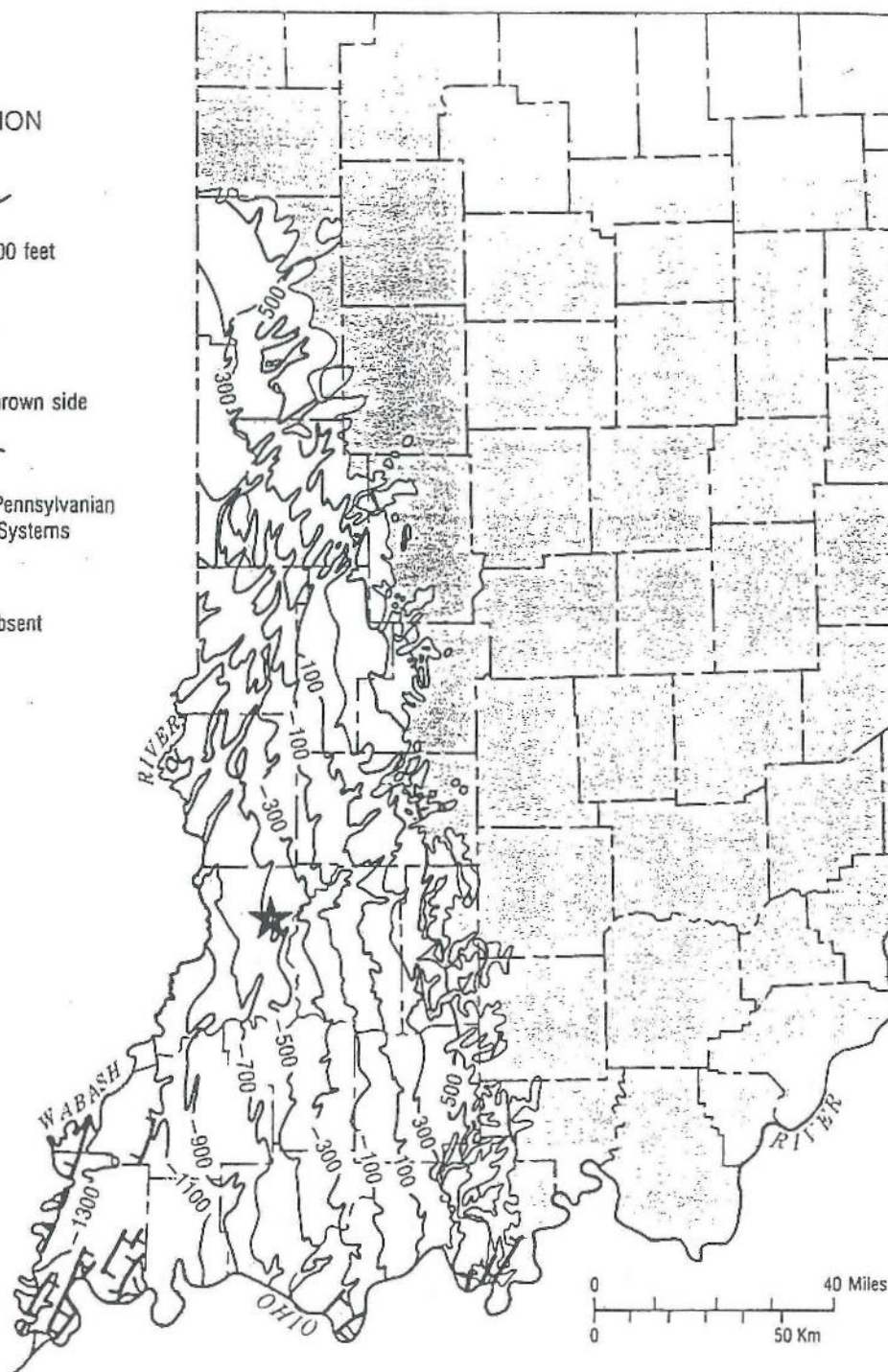
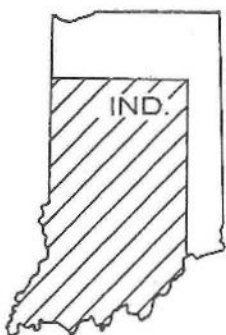
Hachures on downthrown side



Contact between the Pennsylvanian and Mississippian Systems



Pennsylvanian absent



0 40 Miles
0 50 Km



SITE LOCATION

N



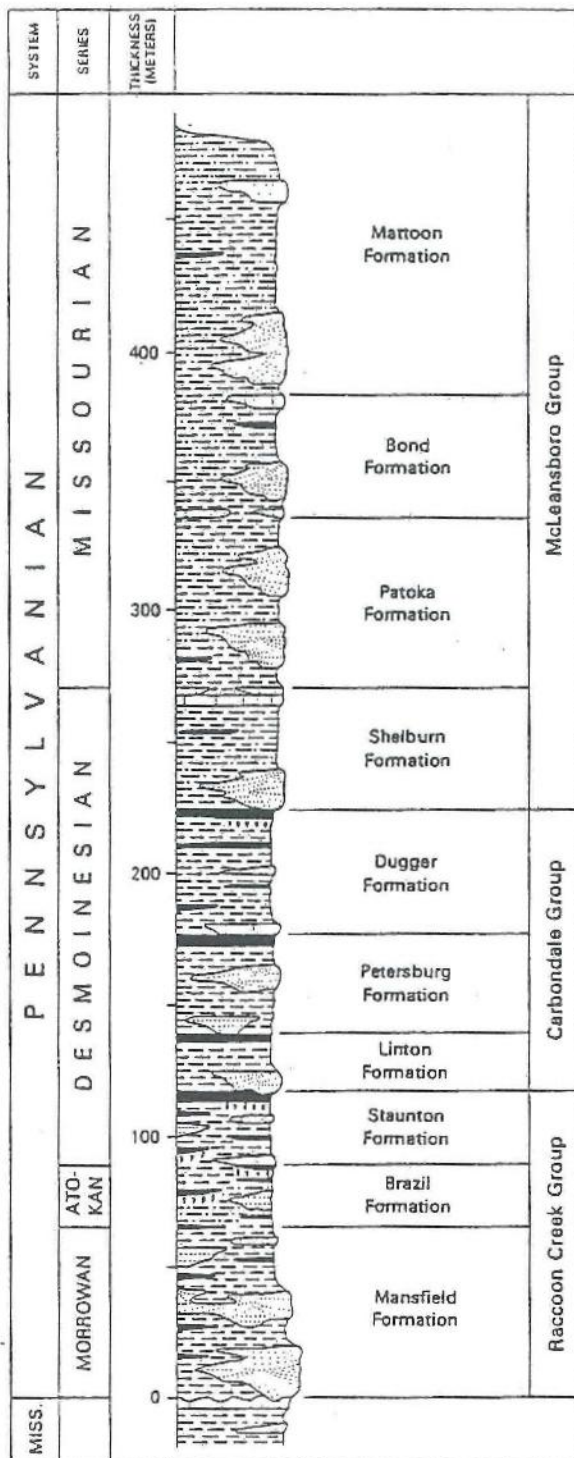
ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.7-2
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP SHOWING STRUCTURE
ON THE BASE OF THE PENNSYLVANIAN

DATE: 5/16/97 CHECKED BY: *Bill* JOB NO: 30A427B
DRAWN BY: CRB APPROVED BY: *MS* DWG. NO:



ENVIROCORP

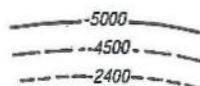
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.2.7-4
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
COLUMNAR SECTION SHOWING EXPOSED
PENNSYLVANIAN ROCKS IN INDIANA


DATE: 5/16/97 CHECKED BY: *BLW* JOB NO: 30A4278
DRAWN BY: CRB APPROVED BY: *MS* DWG. NO:

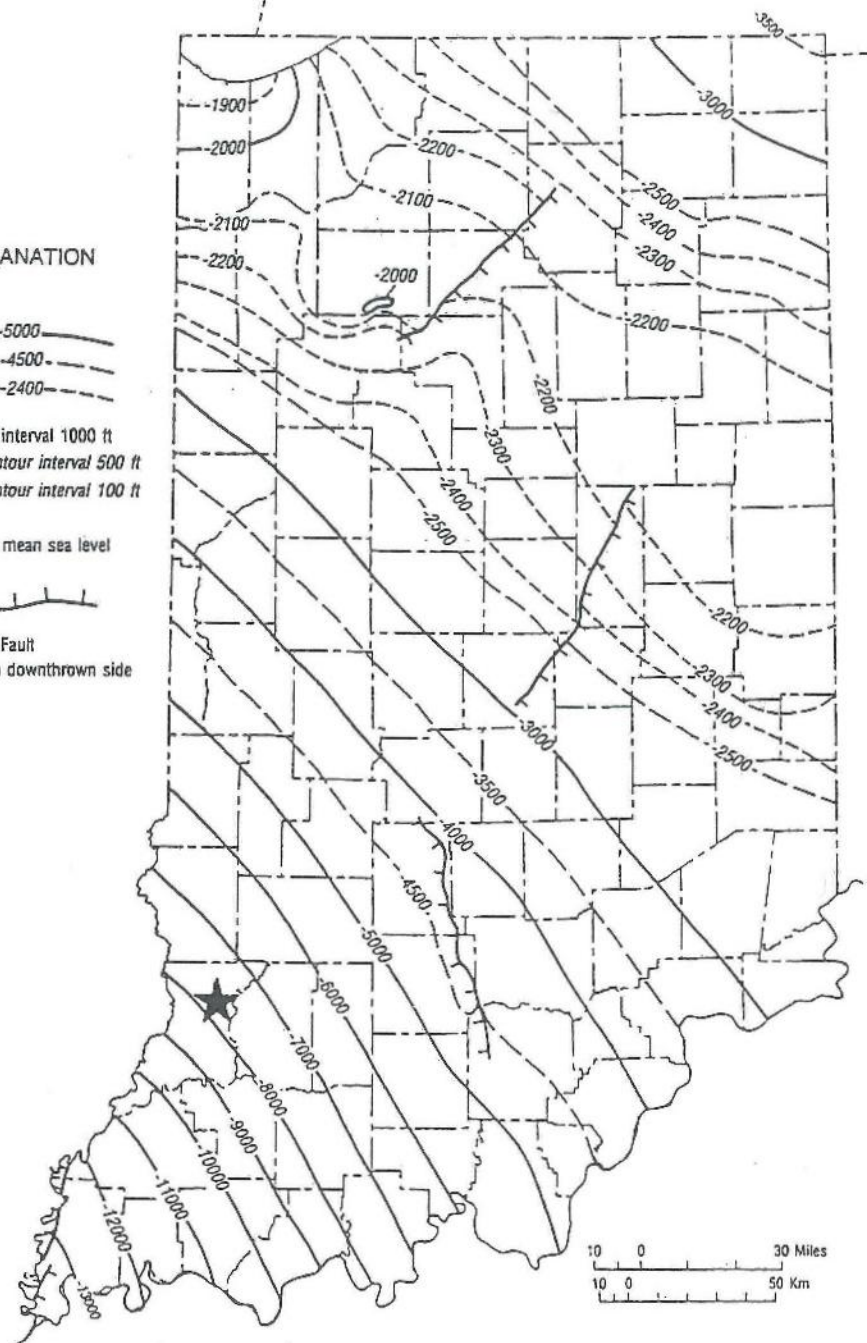
EXPLANATION



Contour interval 1000 ft
Auxiliary contour interval 500 ft
Auxiliary contour interval 100 ft

Datum is mean sea level

 Fault
Hachures on downthrown side



SITE LOCATION



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

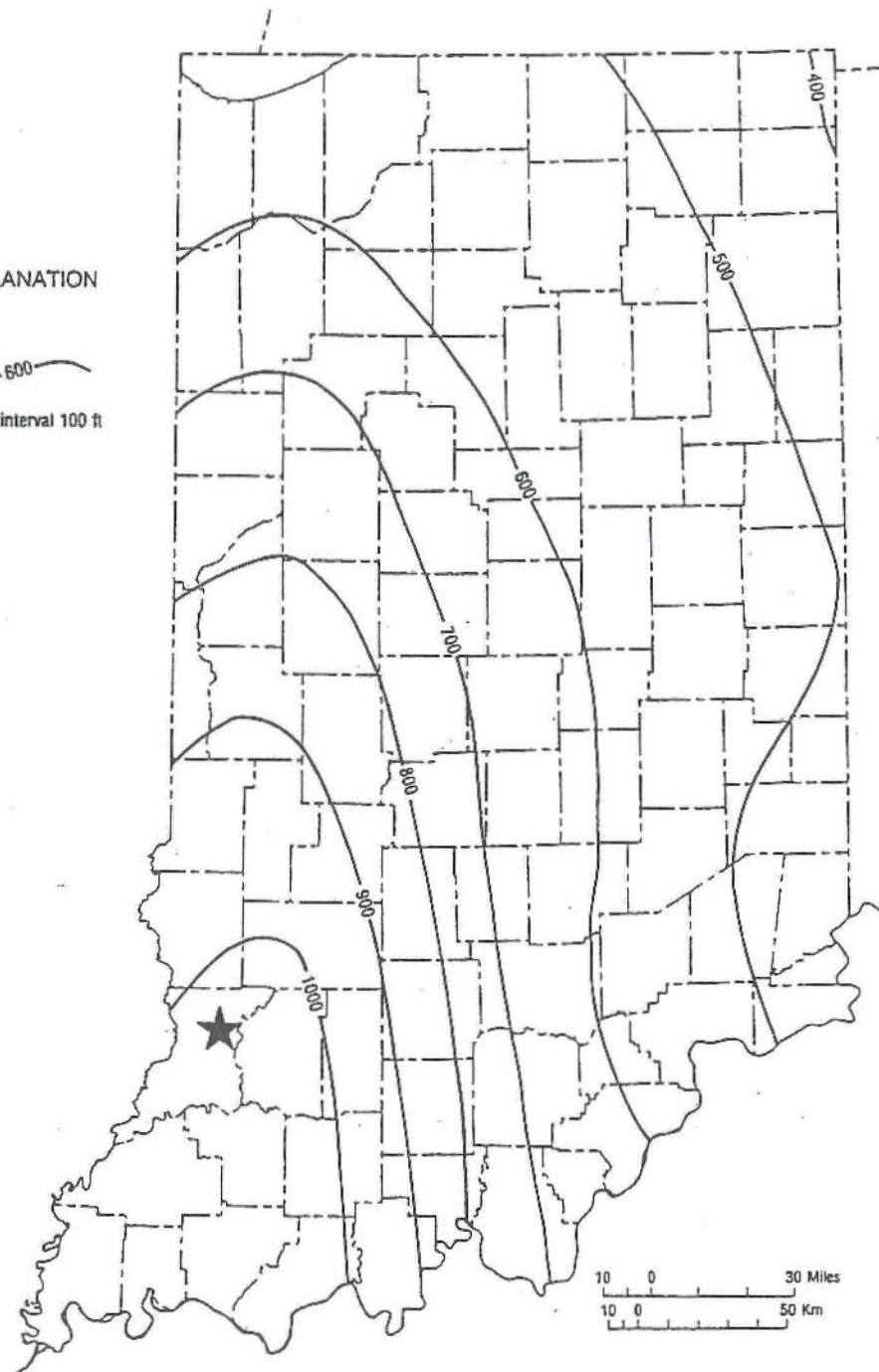
FIGURE 3.3.1-1 SCEPTER INDUSTRIES, INC. BICKNELL, INDIANA

MAP OF INDIANA SHOWING STRUCTURE
ON TOP OF THE MT. SIMON SANDSTONE

DATE: 5/16/97	CHECKED BY: <i>Blm</i>	JOB NO: 30A427B
DRAWN BY: CRB	APPROVED BY: <i>IMS</i>	DWG. NO:

EXPLANATION

600
Contour interval 100 ft



SITE LOCATION



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.3.1-3
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA
MAP OF INDIANA SHOWING THICKNESS
OF THE EAU CLAIRE FORMATION


DATE: 5/16/97	CHECKED BY: <i>BMW</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>MS</i>	DWG. NO:

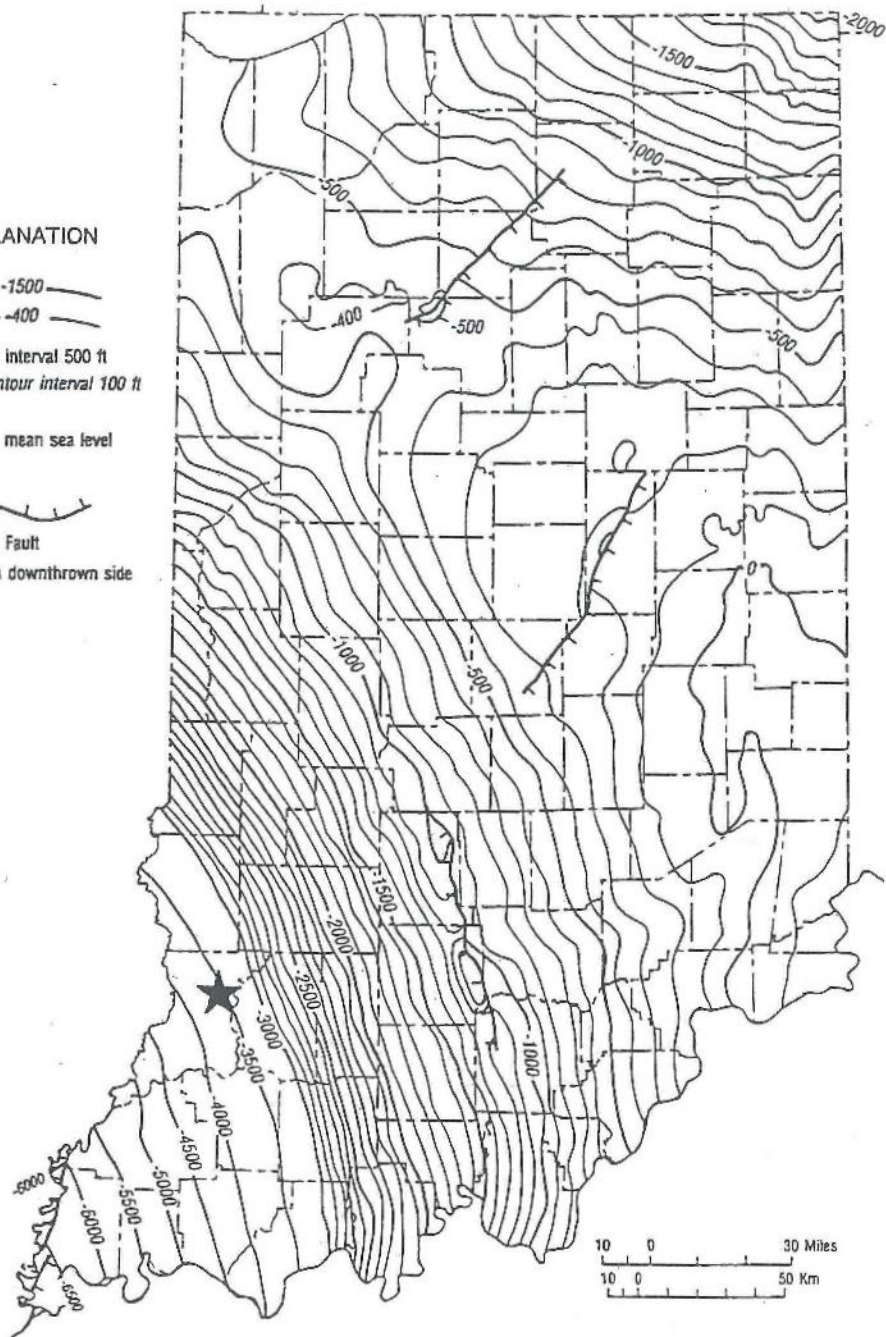
EXPLANATION

—1500—
—400—

Contour interval 500 ft
Auxiliary contour interval 100 ft

Datum is mean sea level


Fault
Hachures on downthrown side



★ SITE LOCATION



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.3.1-5
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP OF INDIANA SHOWING STRUCTURE
ON TOP OF THE BLACK RIVER GROUP

DATE: 5/16/97	CHECKED BY: B.W.V.	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: JMS	DWG. NO:

EXPLANATION

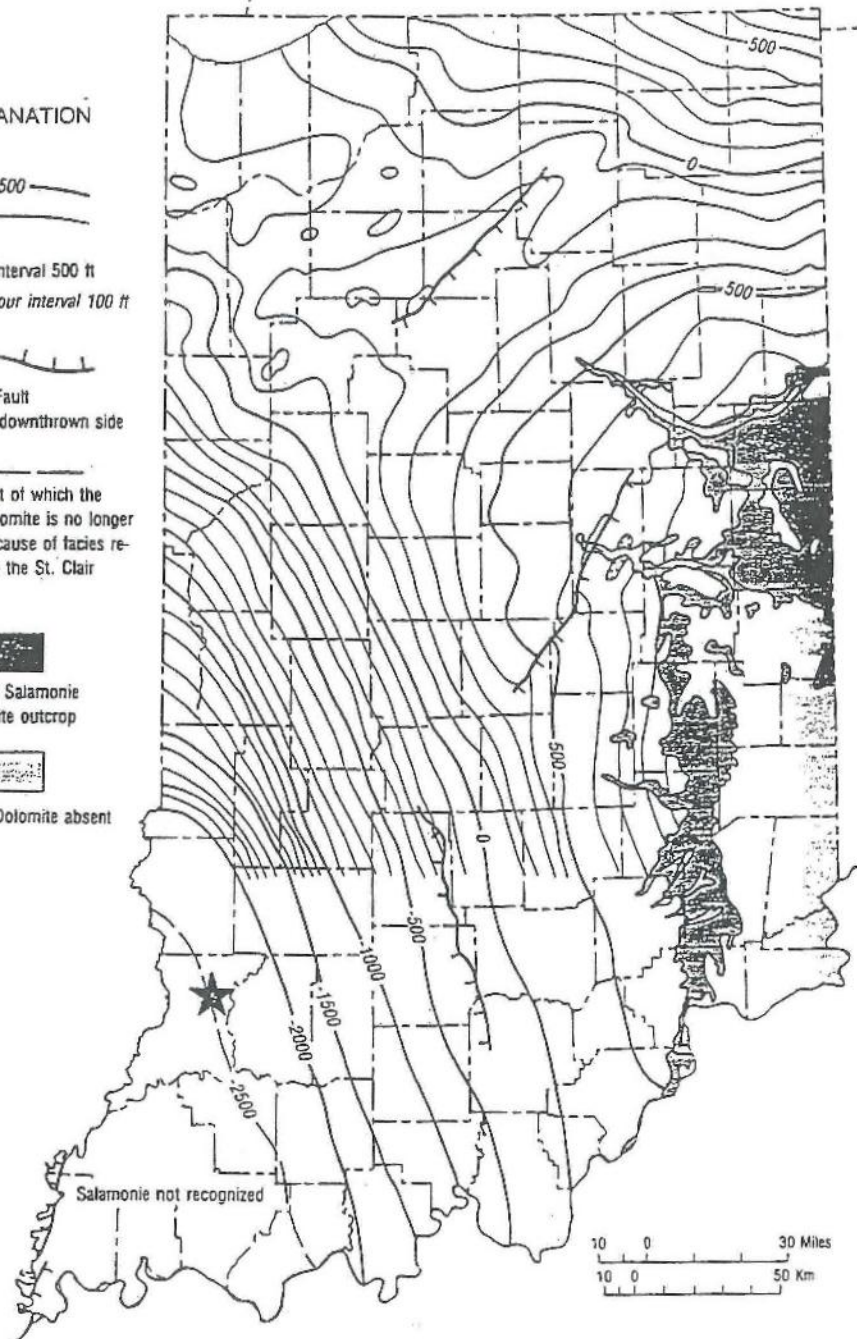
—500—
—500—
Contour interval 500 ft
Auxiliary contour interval 100 ft

—
Fault
Hachures on downthrown side

Line southwest of which the
Salamonie Dolomite is no longer
recognized because of facies re-
lationship with the St. Clair
Limestone

Area of Salamonie
Dolomite outcrop

Salamonie Dolomite absent



SITE LOCATION

N



ENVIROCORP

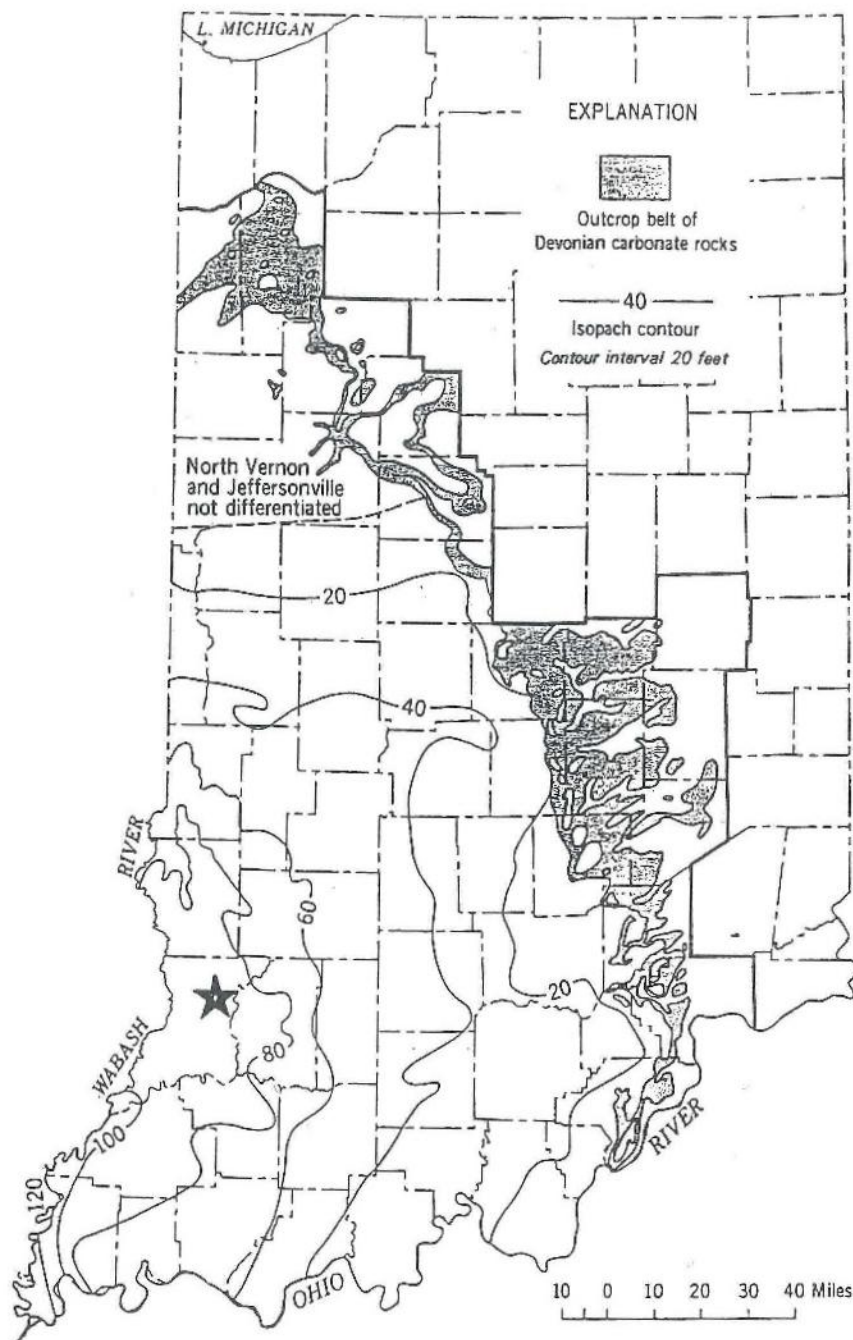
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.3.1-7
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP OF INDIANA SHOWING STRUCTURE
ON TOP OF THE SALAMONIE DOLOMITE

DATE: 5/16/97	CHECKED BY: DWV	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: JMS	DWG. NO:



SITE LOCATION



ENVIROCORP

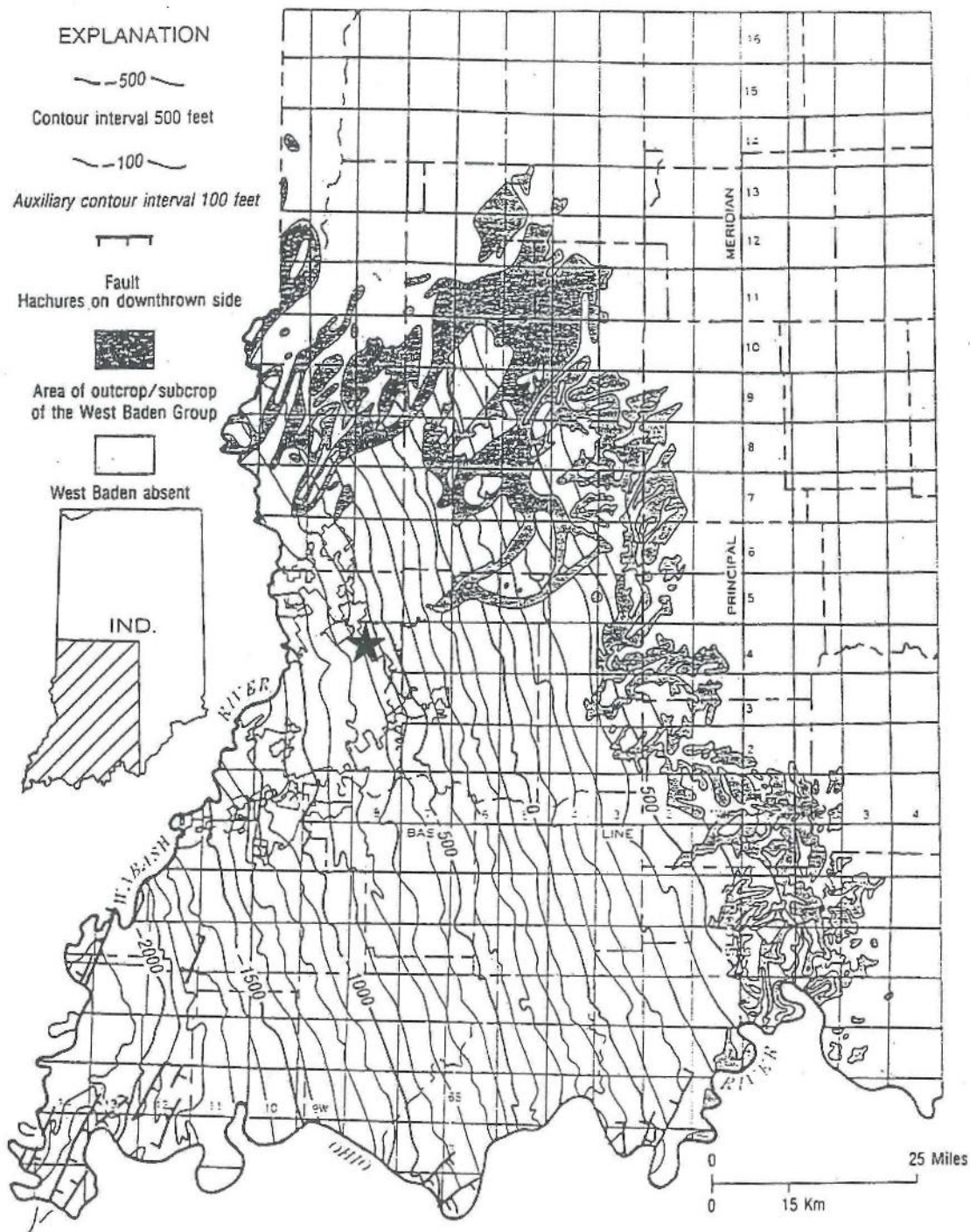
ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.3.1-9
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP OF INDIANA SHOWING THICKNESS
OF THE NORTH VERNON LIMESTONE

DATE: 5/16/97	CHECKED BY: <i>BWN</i>	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: <i>JMS</i>	DWG. NO:



SITE LOCATION

N



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

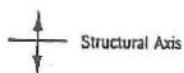
HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.3.1-11
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP OF INDIANA SHOWING STRUCTURE
ON TOP OF THE WEST BADEN GROUP

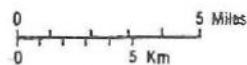
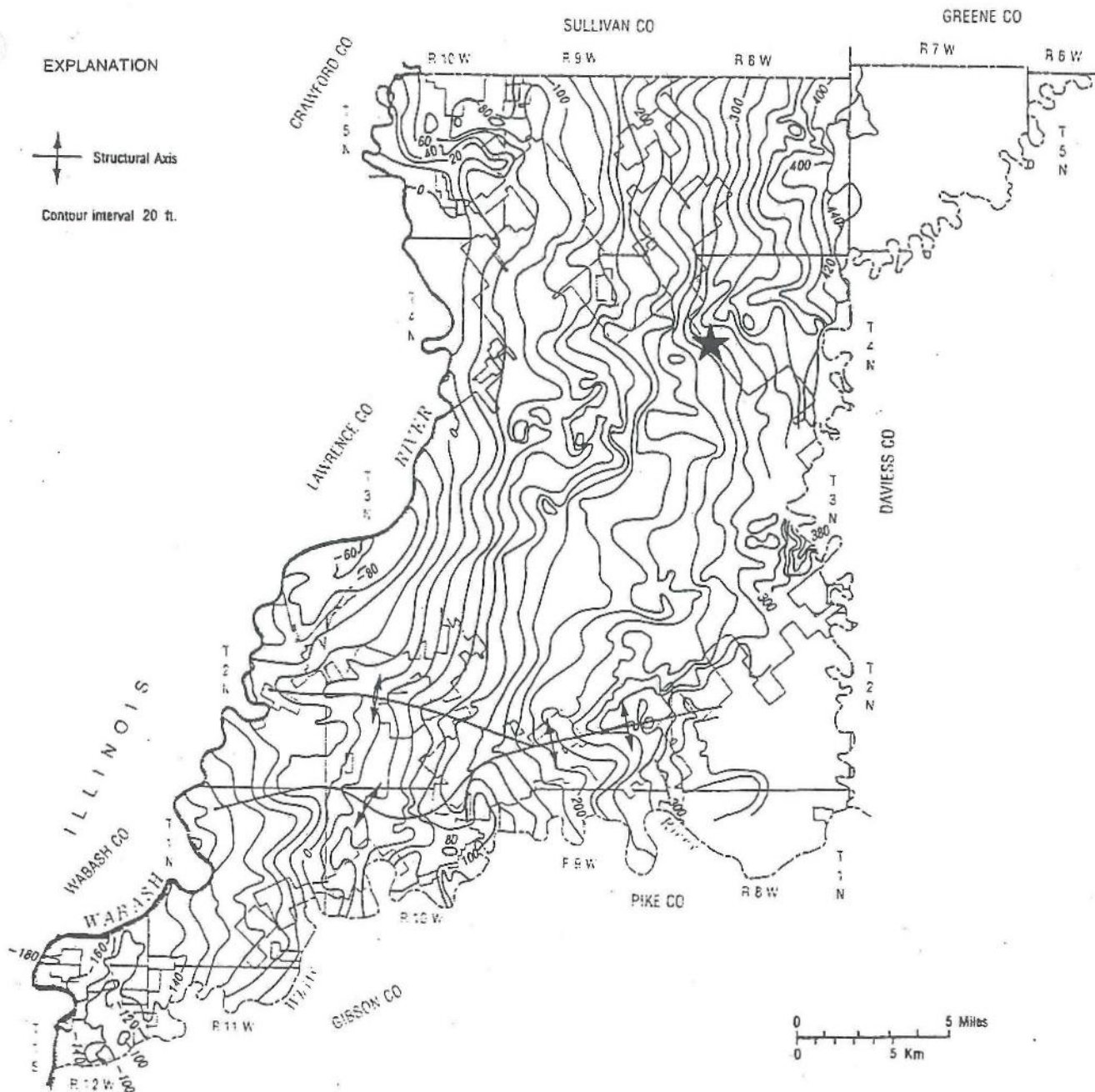
DATE: 5/16/97	CHECKED BY: BWW	JOB NO: 30A4278
DRAWN BY: CRB	APPROVED BY: JMS	DWG. NO:

EXPLANATION



Structural Axis

Contour interval 20 ft.



SITE LOCATION

N



ENVIROCORP

ENVIROCORP SERVICES & TECHNOLOGY, INC.

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 3.3.1-13
SCEPTER INDUSTRIES, INC.
BICKNELL, INDIANA

MAP OF KNOX COUNTY SHOWING THE ELEVATION
RELATIVE TO MEAN SEA LEVEL OF THE TOP
OF THE SPRINGFIELD COAL MEMBER

DATE: 5/16/97	CHECKED BY: <i>BUN</i>	JOB NO: 30A427B
DRAWN BY: CRB	APPROVED BY: <i>JMS</i>	DWG. NO:

Well No. 4

**Chas & Eva McBride No. 1, A. S. Reed
TD - 1965' (1950) (Don 121, T4N, R9W)
Permit No. 8429**

FIELD CHECKED BY C. DILLON, 1978

LOCATION: Don. 124-4N-3W
1920' NWL, 990' NEL
ELEVATION: 518 (Paulin)

STATE OF INDIANA
Division of Oil and Gas
606 State Office Building
Indianapolis, Indiana 46204

API # 13 083-20508

WELL COMPLETION OR RECOMPLETION REPORT AND WELL LOG

TO BE FILED IMMEDIATELY AFTER COMPLETION OF WELL
NOTICE: IT IS NECESSARY TO SUBMIT A RECORD FOR EACH PERMIT.

SIGNATURE Operator <u>JACK ELLIOTT</u> Firm Name <u>LONG</u> Well No. <u>1</u> Permit No. <u>37809</u>	TYPE OF COMPLETION Dry Hole <u>X</u> Stratigraphic Test _____ Oil _____ Saltwater Disposal _____ Gas _____ Water Supply _____ Pressure Maintenance or Gas Storage: _____ Secondary Recovery: Injection - Extraction _____ Water Injection _____ Observation _____ Gas Injection _____																								
TYPE OF WELL New Well <u>X</u> Workover _____ Deepening _____	INITIAL PRODUCTION Oil _____ Gas _____																								
LOCATION County <u>KNOX</u> Twp. <u>4N</u> Rge. <u>8W</u> Section <u>MD 124</u> 1/4 _____ 1/4 _____ 1/4 _____ <u>990</u> from line <u>330</u> from line <u>1920' NWL</u> <u>990' NEL</u>	COMPLETION INTERVAL Interval(s) _____ Formation Name(s) _____																								
LOCATION TION <u>523 (KB)</u>	WELL TREATMENT Shot _____ qts. _____ interval _____ Shot _____ qts. _____ interval _____ Acid _____ gals. _____ interval _____ Acid _____ gals. _____ interval _____ Fracture _____ gals. _____ interval _____ Fracture _____ gals. _____ interval _____																								
TOTAL DEPTH Miller's Log <u>2190</u> Electric Log <u>2194</u>	CASING RECORD <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Size</th> <th>Depth</th> <th>Sks Cement</th> <th>Csg Pulled</th> </tr> </thead> <tbody> <tr> <td><u>8 5/8</u></td> <td><u>66</u></td> <td><u>90</u></td> <td><u>NONE</u></td> </tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Size	Depth	Sks Cement	Csg Pulled	<u>8 5/8</u>	<u>66</u>	<u>90</u>	<u>NONE</u>																
Size	Depth	Sks Cement	Csg Pulled																						
<u>8 5/8</u>	<u>66</u>	<u>90</u>	<u>NONE</u>																						
OPERATIONAL DATES Commenced <u>6-16-78</u> Completed <u>6-23-78</u>	TOOLS Story (interval) <u>0-2190</u> Cable (interval) _____																								

OCCURRENCE OF OIL AND GAS

Interval	Type of Formation (ls., ss., etc.)	Remarks (fill-up, tests, etc.)
----------	---------------------------------------	-----------------------------------

The above information is complete and correct.

Signed Lee Shaffer

Date 7-11-78

Title Field Geologist

Address of Operator Jack Elliott 418 W. 4th Mt. Carmel, Ill. 62863

GIVE COMPLETE FORMATION RECORD ON REVERSE SIDE

Indiana Department of Conservation

Farm Chas. & Eva McBride No. 1
 Company A. S. Reed
 Permit No. 8429 T.D. 1965 P.B.T.D.
 558.2 I.P. D2-A
 Samples Req. Sample No.

casing	
size	depth
10	41

Rotary X Cable NL SL 330'
 Shot Record EL 1530' WL

Acid Record

Pressures

Producing horizons, depths

marks: (Oil shows, d.s.t., p.b., casing perf.)

Date	Activity
4/5/50	Spud
4/20/50	Completed

County
 Twp. 4N Rge. 2E
 Sec. Don. 121
 Loc.
 Civil Twp. Washington
 Pool Wildcat X

Top	Driller or Sample	Elec.
W. Franklin ls.		
Prov. ls.		
Coal No.		
Penn. sd.		
Biehl		
Mansfield ss.		
Up. Kinkaid		
Lo. Kinkaid		
Degonia		
Clore		
Palestine		
Up. Menard		
Main Menard		
L. Menard		
Waltersburg		
"		
Vienna		
Tar Springs		
(Jett)		
Up. Glen Dean		
Main Glen Dean		
Hardinsburg		
(Jones)		
Golconda		
Jackson		
Barlow (Beech Creek)		1298-131
Cypress		1350-142
"		
Pt. Creek		
Pt. Creek		
Bethel-Ben.		
"		
Up. Renault		1428-40
Renault		
Aux Vases		1477-150
"		
"		
Ste. Gen.		1531
O'Hara-Rosiclar		
Fredonia		
McClosky		
"		
"		
St. Louis		
Salem		1954-65
Carper		
Rockford		
New Albany		
Dev. ls.		
"		
"		
Silurian		
Ordovician		
Trenton		
St. Peter		

Well No. 5

**Robert & Hulna Miller No. 1, National Associated Petroleum Co.
TD - 1395' (1950) (Sec 9, T4N, R8W)
Permit No. 9135**

COUNTY OF Knox

WELL PLUGGING AFFIDAVIT

Permit No. 84291A

Type of Bond—\$1,000

—\$5,000 ☒

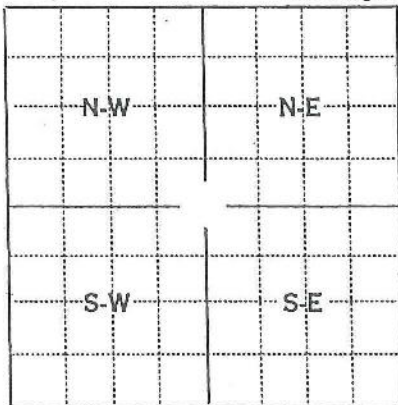
Date Bond released.....

E. W. Pielgremier and John Huger Jr
being first duly sworn, do depose and say the following is a true and correct statement of the details of the plugging of a certain well drilled for

Pool (Name).....

Wildcat ☒

(Indicate whether for oil, gas, water or other purposes)
known as the Charles & Eva McBride no. 1 and located as follows:..... ft. north;
(Well Designation) 330 ft. south; 1530 ft. east;..... ft. west



Locate well accurately on plat of section
(Scale one inch—2,000 ft.)

of the..... corner of the..... Quarter
of the..... Quarter of the..... Quarter of
Section MD 12.1, Township 4 (North or ~~South~~)
Range 9 (~~East~~ or West), in Washington
Civil Twp., Knox County, Indiana.

Elevation above sea level is { Derrick Floor 560 ft.
Ground 558.7 ft.

Total depth of well is 1965 ft.Date permit to drill issued 4-3-50Permit issued to A. S. ReedDate drilling began Apr 6 - 50Date drilling completed Apr 13 - 50Kind of drilling tools used RotaryDate plugging began 4-14-50Date plugging completed 4-14-50

Lessor (Farm Owner) Charles & Eva McBride Address Bicknell R.R.
Lessee (Operator) A. S. Reed Address Sullivan Ind.
Drilling Contractor Allied Drilling Co. Address Carlisle Ind.

DETAILS OF PLUGGING:

Filled with Drill Mud From 1965 To 360 feet
(Rotary Mud, Cement, or Other Materials)
Kind of Plug Cement From 360 To 250 feet
Filled with Drill Mud From 250 To 30 feet
Kind of Plug Cement From 30 To 2 feet
Filled with Clay From 2 To 0 feet
Kind of Plug..... From..... To..... feet
Filled with..... From..... To..... feet
Kind of Plug..... From..... To..... feet

IF WORKABLE COAL BEDS WERE ENCOUNTERED IN THIS HOLE, DESCRIBE THE METHOD EMPLOYED TO PROTECT SAME. (A workable coal bed is thirty inches or more in thickness above 1,000 feet in depth).....

(1) Have pits, cellar and other excavations been filled?.....

Yes ☒No ☐

(2) Have equipment, concrete bases and debris been removed?.....

Yes ☒No ☐

(3) Has surface casing been cut off below plow depth?.....

Yes ☒No ☐

(4) Has well-site been levelled?.....

Yes ☒No ☐

If this was a producing well, give date and amount of last production.....

dry

CASING RECORD

Size	PUT IN WELL Feet Inches	PULLED OUT Feet Inches	LEFT IN WELL Feet Inches	Remarks
<u>8 7/8</u>	<u>41</u>	<u>0</u>	<u>38</u>	

A. S. Reed
(Signature of person, firm or corporation having custody or control of well.)
Per John Huger Jr
Address Sullivan Ind.
E. W. Pielgremier
(Signature and title of party supervising plugging of well.)
Address Carlisle Ind.

Subscribed and sworn to before me this 14 day of April, A. D. 1950.My commission expires April 30, 1953 Helen Louise Pielgremier

Notary Public.

Notary Public.

WELL PLUGGING AFFIDAVIT

Permit No. 9135

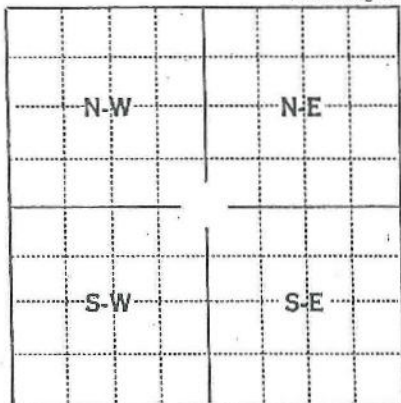
Type of Bond—\$1,000

—\$5,000

Date Bond released

E. W. Pielmeier and Lawrence O. Tark being first duly sworn, do depose and say the following is a true and correct statement of the details of the plugging of a certain well drilled for Pool (Name) Oil Wildcat X

known as the Robt A. & Hulda Miller No. (Indicate whether for oil, gas, water or other purposes) and located as follows: 330 ft. north; (Well Designation) ft. south; ft. east; 330 ft. west



Locate well accurately on plat of section
(Scale one inch=2,000 ft.)

of the NE corner of the SW Quarter of the NE Quarter of the NE Quarter of Section 9, Township 4 (North or South) Range 8, (East or West), in Wigo Civil Twp., Knott County, Indiana.

Elevation above sea level is { Derrick Floor ft. Ground 495.5 ft.

Total depth of well is 1394 ft.

Date permit to drill issued 7-7-50

Permit issued to National Assn. Pet. Co.

Date drilling began 8-11-50

Date drilling completed 8-16-50

Kind of drilling tools used Rotary

Date plugging began 8-16-50

Date plugging completed 8-16-50

Lessor (Farm Owner) Robert Miller Address Bicknell R.R.
Lessee (Operator) National Assn. Pet. Co. Address 234 KC Bldg Washington D.C.
Drilling Contractor Exploration Drilling Co. Address 234 KC Bldg Washington D.C.

DETAILS OF PLUGGING:

Filled with Rotary Mud From 1394 To 370 feet
(Rotary Mud, Cement, or Other Material)

Kind of Plug Cement From 370 To 310 feet

Filled with Left for water well at From 310 To ft.

Kind of Plug Robert Miller's request From ft. To ft.

Filled with Robert Miller's request From ft. To ft.

Kind of Plug Robert Miller's request From ft. To ft.

Filled with Robert Miller's request From ft. To ft.

Kind of Plug Robert Miller's request From ft. To ft.

IF WORKABLE COAL BEDS WERE ENCOUNTERED IN THIS HOLE, DESCRIBE THE METHOD EMPLOYED TO PROTECT SAME. (A workable coal bed is thirty inches or more in thickness above 1,000 feet in depth) Coal 80-84 and 120-125 protected with surf pipe

- (1) Have pits, cellar and other excavations been filled? Yes ☒ No ☐
(2) Have equipment, concrete bases and debris been removed? Yes ☒ No ☐
(3) Has surface casing been cut off below plow depth? Yes ☒ No ☐
(4) Has well-site been levelled? Yes ☒ No ☐

If this was a producing well, give date and amount of last production dry

CASING RECORD

Size	PUT IN WELL Feet Inches	PULLED OUT Feet Inches	LEFT IN WELL Feet Inches	Remarks
<u>10 3/4 215</u>		<u>0</u>	<u>215</u>	

Natl. Assn. Pet. Co. (Signature of person, firm or corporation having custody or control of well)

Per. Lawrence O. Tark

Address 234 KC Bldg Washington D.C.

E. W. Pielmeier (Signature and title of party supervising plugging of well)

Address 7 realandville

Subscribed and sworn to before me this 16 day of August, A. D. 19 50

My commission expires April 30, 1953 Edward Pielmeier

Notary Public.

ATTACHMENT C
GLOSSARY OF GEOLOGIC TERMS

ATTACHMENT C

GLOSSARY OF GEOLOGIC TERMS

Anhydrite - A mineral, anhydrous calcium sulfate, CaSO_4 , commonly massive in evaporite beds.

Alluvium - A general term for deposits resulting from the operations of modern rivers, thus including the sediments laid down in river beds, flood plains, lakes, fans at the foot of mountain slopes, and estuaries.

Anticlinal - Incline toward each other.

Arch - An anticline.

Arose - A feldspar-rich, typically coarse-grained sandstone composed of angular to subangular grains that may be either poorly or moderately well-sorted, usually derived from the rapid disintegration of granite or granitic rocks (including high-grade feldspathic gneisses and schists), and often closely resembling or having the appearance of a granite.

Argillaceous - A rock containing appreciable clay.

Artesian - An adjective referring to ground water confined under hydrostatic pressure.

Aquifer - A body of rock that contains sufficient saturated permeable material to conduct ground water and to yield economically significant quantities of ground water to wells and springs.

Basin - An extensive depressed area into which the adjacent land drains, and having no surface outlet.

Bioclastic - Refers to rocks consisting of fragmental organic remains (i.e., sea shells).

Bioherm - A mound or reef-like or otherwise circumscribed mass of rock built up by, and composed almost exclusively of, the remains of sedentary organisms and enclosed or surrounded by rock of different lithology: e.g., an organic reef or a nonreef limestone mound.

Breccia - A rock made up of highly angular coarse fragments.

Calcarenite - A limestone or dolomite composed of coral or shell sand or of sand derived from the erosion of older limestones.

Calcareous - Containing calcium carbonate.

Cambrian - A geologic time period.

Friable - Easily crumbled, as would be the case with rock that is poorly cemented.

Geophysical Log - A log obtained by lowering an instrument into a borehole or well and recording continuously on a meter at the surface some physical property of the rock material being logged.

Gneiss - A foliated rock formed by regional metamorphism in which bands or lenticles of granular minerals alternate with bands and lenticles in which minerals having flaky or elongate prismatic habits predominate.

Glaciation - Alteration of the earth's solid surface through erosion and deposition of glacier ice.

Glauconite - A green mineral, closely related to the micas and essentially a hydrous potassium iron silicate.

Hematite - The principal ore of iron.

Interbedded - Occurring between beds, or lying in beds parallel to other beds of a different material.

Igneous - Formed by solidification from a molten or partially molten state.

Intrusive - Having, while fluid, penetrated into or between other rocks, but solidifying before reaching the surface.

Isopach Map - A map that shows the thickness of a bed, formation, sill, or other tabular body throughout a geographic area, based on a variety of types of data; a map that shows the varying true thickness of a designated stratigraphic unit or group of stratigraphic units by means of isopachs plotted normal to the bedding or other bounding surface at regular intervals.

Karst - A type of topography that is formed over limestone, dolomite, or gypsum by dissolving or solution, and that is characterized by closed depressions or sinkholes, caves, and underground drainage.

Lacustrine - Pertaining to, produced by, or formed in a lake or lakes; e.g. "lacustrine sands" deposited on the bottom of a lake, or a "lacustrine terrace" formed along the margin of a lake.

Leachate - A solution obtained by leaching; e.g. water that has percolated through soil containing soluble substances and that contains certain amounts of these substances in solution.

Lithographic - An exceedingly fine-grained stone.

Stromatolite - Laminated but otherwise structureless calcareous objects; commonly called fossil calcareous algae.

Subsidence - A sinking of a large part of earth's crust.

Syncline - A fold in rocks in which the strata dip inward from both sides toward the axis.

TDS - Total Dissolved Solids.

Terrigenous - Produced from or of the earth.

Transgression - Gradual expansion of a shallow sea resulting in the progressive submergence of land, as when sea level rises or land subsides.

Truncate - To cut the top or end from; to terminate abruptly as if cut or broken off.

USDW - Underground Source of Drinking Water having less than 10,000 mg/l of total dissolved solids.

Unconformity - A surface of erosion or nondeposition, usually the former that separates younger strata from older rocks.

Vug - A cavity, often with evenly sloping sides, is often called V-shaped and the V is narrow or broad according to the amount of wasting which has taken place.

Sources:

Dictionary of Geologic Terms, Anchor Press, Doubleday, Garden City, New York, 1974.

Glossary of Geology, American Geological Institute, Falls Church, Virginia, 1974.

Appendix B

AOR Test Hole Completion Logs and Plugging Affidavits

Appendix B
AOR Abandoned, Plugged and Dry Holes

IGS ID	Total Depth (feet)	Terminal Formation	Location (Township, Range, and Section or Military Donation)
123076	1965	Salem	4N, 9W, Donation 121
123057	407	Pennsylvanian	4N, 9W, Donation 144
123082	1719	St. Louis	4N, 9W, 10
150125	1465	St. Genevieve	4N, 9W, Donation 1
123067	1595	St. Louis	4N, 9W, Donation 1
123083	1570	St. Louis	4N, 9W, 11
150123	900	Pennsylvanian	4N, 9W, 2
150124	340	Pennsylvanian	4N, 9W, 2
123052	407	Pennsylvanian	4N, 8W, Donation 231
123053	181	Pennsylvanian	4N, 8W, Donation 231

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

IGS ID: 123076

All depths and distances are in feet except UTM's(meters).

Record Last Modified: 09/05/201

Military Donation

121- 4 N- 9 W -

1530 NEL 330 SEL

UTM-X: 467562

Completion

dry hole

Posted TD: 1965

Elevation: 562

UTM-Y: 4291020

Spotting Method: Imported

Knox, IN

Bicknell

Field Check: Checked

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
8429		04/20/1950	dry hole	1965	Salem	1	Reed	McBride	

Samples: Sample Int.: 100-1900 ; BoxNumber: 3962 ; Lithologic Strip -- |

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

2

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)**IGS ID: 123057***All depths and distances are in feet except UTM's(meters)*

Record Last Modified: 09/05/20

Military Donation

144-4 N-9 W -

450 SWL 2050 SE1

UTM-X: 467714

Completion

dry hole

Posted TD: 407

Elevation: 542

UTM-Y: 4291810

Spotting Method: Imported

Knox, IN

Bicknell

Field Check: Checked

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
0		01/14/1974	dry hole	407	Pennsylvanian	1	Dikor	Berry	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

3

IGS ID: 123082

All depths and distances are in feet except UTM's(meters)

Record Last Modified: 09/05/2003

Section 10-4 N-9 W -
dry hole Posted TD: 1719
Knox, IN
location distance is given from WL of Survey 41; pub. 108

1760 SL 310 WL
Elevation: 472

UTM-X: 465541
UTM-Y: 4293656
Oaktown

Completion
Spotting Method: Measured
Field Check: Checked

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
0		12/22/1921	dry hole	1719	St. Louis	2	Zizehouse	Richey	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

IGS ID: 150125

All depths and distances are in feet except UTM's(meters)

Record Last Modified: 09/05/2003

Survey

I- 4 N- 9 W -

400 SL 1070 WL

UTM-X: 465939

Completion

dry hole

Posted TD: 1465

Elevation: 473

UTM-Y: 4293720

Spotting Method: Imported

Knox, IN

Oaktown

Field Check: Checked

compl. year uncertain; TD & TD fm uncertain

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
0		01/01/1912	dry hole	1465	Ste. Genevieve	1	Alzchouse	Richey	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

IGS ID: 123067

All depths and distances are in feet except UTM(meters)

Record Last Modified: 09/05/2003

Survey

1- 4 N- 9 W -

330 SL 800 WL

UTM-X: 465864

Completion

dry hole

Posted TD: 1595

Elevation: 481

UTM-Y: 4293726

Spotting Method: Imported

Knox, IN

Oaktown

Field Check: Checked

TD form uncertain.

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
8023		12/22/1949	dry hole	1595	St. Louis	1	Messmer	Gognat	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

IGS ID: 123083

All depths and distances are in feet except UTM's(meters)

Record Last Modified: 09/05/

Section

11- 4 N- 9 W SE- SW- NW

330 St. 250 El.

UTM-X: 466415

Completion

dry hole

Posted TD: 1570

Elevation: 493

UTM-Y: 4294060

Spotting Method: Imported

Knox, IN

Oaktown

Field Check: Checked

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
7915		12/15/1949	dry hole	1570	St. Louis	1	Messmer Oil	Cummins	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

77

IGS ID: 150123

All depths and distances are in feet except UTM(meters)

Record Last Modified: 09/05/

Section

2-4 N-9 W NW-SE-NW

60 NL 160 WL

UTM-X: 466492

Completion

dry hole

Posted TD: 900

Elevation: 470

UTM-Y: 4295930

Spotting Method: Imported

Knox, IN

Oaktown

Field Check: Checked

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
692		12/05/1984	dry hole	900	Pennsylvanian	15	Shot Point Services	Hill	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

8
6

IGS ID: 150124

All depths and distances are in feet except UTM(meters)

Record Last Modified: 09/05/2003

Section

2-4 N-9 W NW-SE-NW

0 0

UTM-X: 466461

Completion

dry hole

Posted TD: 340

UTM-Y: 4295930

Spotting Method: Imported

Knox, IN

Oaktown

Field Check: Checked or Reviewed

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
692		12/12/1984	dry hole	340	Pennsylvanian	15CHI	Shot Point Services	Hill	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)**IGS ID: 123052***All depths and distances are in feet except UTM's(meters)*

Record Last Modified: 09/05/20

Military Donation

231-4 N-8 W

2178 NWL 720 SWL

UTM-X: 469957

Completion

dry hole

Posted TD: 407

Elevation: 535

UTM-Y: 4293712

Spotting Method: Measured

Knox, IN

Bicknell

Field Check: Checked

may be many wells with same number.

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
34567 CST		01/05/1974	dry hole	407	Pennsylvanian	1	Dikar	Worland	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Well History Report - Indiana Geological Survey, Petroleum Database Management System (PDMS)

IGS ID: 123053

All depths and distances are in feet except UTMs(meters)

Record Last Modified: 09/05/20

Military Donation

231-4 N-8 W -

2178 NW1/4 730 SWL

UTM-X: 469960

Completion

dry hole

Posted TD: 181

Elevation: 535

UTM-Y: 4293714

Spotting Method: Measured

Knox, IN

Bicknell

Field Check: Checked

may be many wells with same number.

Event: 1

Permit No	Permit Date	Comp. Date	Status	TD	TD Formation	Number	Operator	Lease	Release Date
34567 CST		01/15/1974	dry hole	181	Pennsylvanian	2	Dikor	Worland	

Please refer to the PDMS at the Indiana Geological Survey website for important information regarding data reliability and disclaimers.

Appendix C

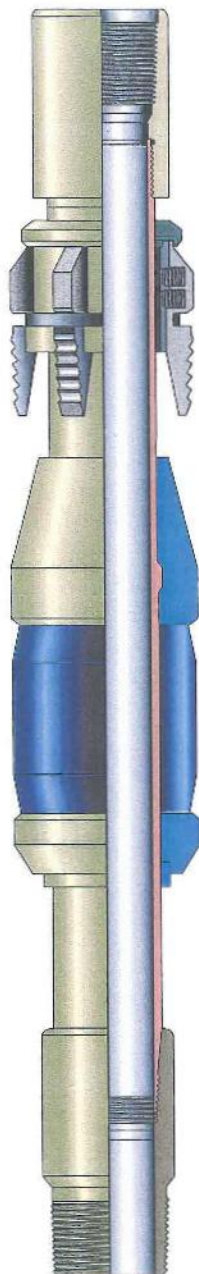
Specification Sheets Packer, Tubing and Corrosion Inhibitor Fluid

AD-1 Tension Packer

Product Information

COMPLETION

PRODUCTS
AND
SERVICES



AD-1 Tension Packer

Application

The AD-1 Tension Packer is a retrievable, tension-set packer that holds high pressure from below in applications where a set-down packer is not suitable. Used primarily as a waterflood packer, it is also used for other pressurizing applications such as low fluid level or shallow acidizing or fracturing.

The ADL-1 model is a large bore version of the AD-1 packer. The larger packer bore allows wireline tools to pass through and higher injection rates.

Features and Benefits

- Compact size.
- Field-proven slip design has been used in thousands of wells.
- Packer bore is larger than tubing drift diameter.
- Larger packer bore allows easy passage of wireline tools and higher injection rates.
- J-Latch control provides trouble-free setting and retrieving.
- Shear or right-hand emergency releases for difficult retrievals.

Operation

- Run in the well to the desired setting depth (the last movement must be downward).
- Rotate the tubing 1/4 turn to the left at the tool.
- Pick up a maximum of 5,000 lbs (2,268 kg) to obtain pack off.
- To release, lower the tubing 1 ft more than is necessary to relieve the tension and rotate the tubing to the right 1/4 turn at tool.


AD-1 Tension Packer

Product Information

Specifications							
Casing				Packer			
Casing OD (in)	Weight lbs (kg)	Range of Casing ID (in)		Size (in)	Nom. ID (in)	Guide Ring OD (in)	Std Thread Specs Box Up & Pin Down (in)
		(Min)	(Max)				
4 1/2	9.5-13.5 (4.3-6.1)	3.910	4.160	43A	1.97	3.771	2 3/8 OD EU 8 RD
5	15-18 (6.8-8.2)	4.161	4.408	43B	1.97	4.125	2 3/8 OD EU 8 RD
	11.5-15 (5.2-6.8)	4.408	4.560	43C		4.250	
5 1/2	26 (11.8)	4.408	4.560	43C	1.97	4.250	2 3/8 OD EU 8 RD
	20-23 (9.1-10.4)	4.625	4.778	45A2		4.500	
	15.5-20 (7.0-9.1)	4.778	4.950	45A4		4.641	
	13-15.5 (5.9-7.0)	4.950	5.190	45B		4.781	
5 3/4	22.5 (10.2)	4.950	5.190	45B	1.97	4.781	2 3/8 OD EU 8 RD
6	26 (11.8)	4.950	5.190	45B	1.97	4.781	2 3/8 OD EU 8 RD
	20-23 (9.1-10.4)	5.191	5.390	45C		5.062	
	15-18 (6.8-8.2)	5.391	5.560	45D		5.156	
6 5/8	24 (10.9)	5.830	5.921	47A2	2.42	5.656	2 7/8 OD EU 8 RD
	17-20 (7.7-9.1)	5.922	6.135	47A4		5.812	
7	38 (17.2)	5.830	5.921	47A2	2.42	5.656	2 7/8 OD EU 8 RD
	32-35 (14.5-15.9)	5.922	6.135	47A4		5.812	
	26-29 (11.8-13.2)	6.136	6.276	47B2		5.968	
	20-26 (9.1-11.8)	6.276	6.456	47B4		6.078	
	17-20 (7.7-9.1)	6.456	6.538	47C2		6.266	
7 5/8	33.7-39 (15.3-17.7)	6.539	6.765	47C4	2.42	6.453	2 7/8 OD EU 8 RD
	24-29.7 (10.9-13.5)	6.766	4.025	47D2		6.672	
	20-24 (9.1-10.9)	7.025	7.125	47D4		6.812	
8 5/8	40-49 (18.1-22.2)	7.511	7.725	49A2	3.00	7.312	3 1/2 OD EU 8 RD
	32-40 (14.5-18.1)	7.725	7.921	49A4		7.531	
	20-28 (9.1-12.7)	7.922	8.191	49B		7.781	
9 5/8	47-53.5 (21.3-24.3)	8.300	8.681	51A2	4.00	8.218	4 1/2 OD 8 RD LG CSG
	40-47 (18.1-21.3)	8.681	8.835	51A4		8.437	
	29.3-36 (13.3-16.3)	8.836	9.063	51B		8.593	
5 1/2	13-17 (5.9-7.7)	4.876	5.044	45B x 2.90 ADL-1	2.90	4.750	3 1/2 OD EU 8 RD
6	23-26 (10.4-11.8)	5.140	5.240	45C x 2.90 ADL-1	2.90	5.000	3 1/2 OD EU 8 RD
	18-20 (8.2-9.1)	5.241	5.424	45D x 2.90 ADL-1		5.218	

The above features and/or data are supplied solely for informational purposes and BJ Services Company makes no guarantees or warranties, either expressed or implied, with respect to their accuracy or use. All product warranties and guarantees shall be governed by the BJ Services Company standard at the time of sale or delivery of service. Actual product performance or availability depends on the timing and location of the job, the type of job and the particular characteristics of each job. This document is controlled by the reference data. To ensure that this is the current version, please reference the Services section of the BJ Services Website (www.bjservices.com) or ask your BJ representative.

3/12/03

 BJ SERVICES COMPANY





- Duoline Products
- Company Information
- Technical Support
- Quotes & Inquiries
- Online Library/Resources
- Duoline Case Studies
- Pipeline Club Members



Duoline Pipeline Club

Join Duoline.com to receive product updates and gain instant access to helpful information

Duoline Employment Opportunities

Learn how to join our team. Up-to-date employment listings for Duoline Technologies locations.

Enter Keyword, Term or Phrase To Search Our Site:

[Submit Query](#) | [Site Map](#) | [Request Literature Online](#) | [Questions? Contact Us](#)

Duoline API And Premium Connection Comparison

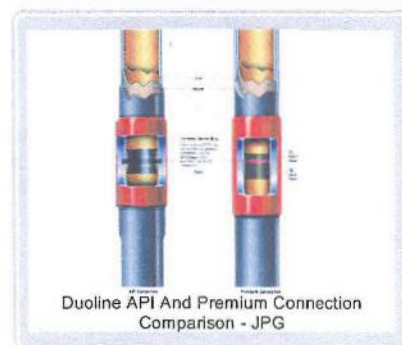
Duoline technical illustration

View the Duoline illustration to the right for overview of API and Premium Connections.

The workhorse of the DUOLINE® lining systems. DUOLINE® 20, developed by Duoline Technologies in 1971, is targeted for more demanding corrosive downhole environments. The DUOLINE® 20 system has a proven track record in a great number of demanding environments including water injection, CO₂ injection, gas production, gas-lifted oil production and chemical disposal wells, onshore and offshore. DUOLINE® 20 has an outstanding performance history in environments containing produced fluids and gases with CO₂ and H₂S. DUOLINE® 20 has successfully prevented corrosion in gas production wells with BHT as high as 292°F (144°C), and is typically used in water injection and gas production service up to 250°F (121°C).

The DUOLINE® 20 liner is fabricated exclusively by Duoline Technologies. The liner is a GRE composite (glass reinforced epoxy resin system) manufactured with a filament winding and high temperature cure process. The only fiberglass-epoxy lining system in the marketplace today with over 33 years of accumulated field history. Duoline Technologies and DUOLINE® 20 have pioneered the trend for fiberglass-liner acceptance around the world. DUOLINE® 20 is manufactured and available in a number of international locations.

DUOLINE® 20 has proven to be the most abrasion resistant coating or lining product in downhole wireline trials in deviated wells. It is acid compatible, impact resistant, resistant to gas service failures common to other coatings



See page 4
for PVC
10-PVC

DUOLINE® DIMENSIONS AND WEIGHTS
For API Connections


API Size	OD	ID	Weight (lb/ft)	Weight (kg/m)
1/2"	1.315	1.049	1.70	0.25
3/4"	1.675	1.315	2.50	0.37
1"	2.000	1.640	3.50	0.51
1 1/4"	2.375	1.915	5.00	0.73
1 1/2"	2.625	2.165	6.00	0.88
2"	3.000	2.540	8.00	1.18
2 1/2"	3.375	2.915	11.00	1.61
3"	3.750	3.290	14.00	2.04
3 1/2"	4.125	3.665	18.00	2.64
4"	4.500	4.040	22.00	3.24
4 1/2"	4.875	4.415	27.00	3.97
5"	5.250	4.790	32.00	4.70
5 1/2"	5.625	5.165	38.00	5.55
6"	6.000	5.540	44.00	6.40
6 1/2"	6.375	5.915	51.00	7.35
7"	6.750	6.290	58.00	8.30
7 1/2"	7.125	6.665	66.00	9.35
8"	7.500	7.040	74.00	10.40
8 1/2"	7.875	7.415	83.00	11.55
9"	8.250	7.790	92.00	12.70
9 1/2"	8.625	8.165	102.00	13.95
10"	9.000	8.540	112.00	15.20
10 1/2"	9.375	8.915	123.00	16.55
11"	9.750	9.290	134.00	17.80
11 1/2"	10.125	9.665	146.00	19.15
12"	10.500	10.040	158.00	20.50
12 1/2"	10.875	10.415	171.00	21.95
13"	11.250	10.790	184.00	23.40
13 1/2"	11.625	11.165	198.00	24.85
14"	12.000	11.540	212.00	26.30
14 1/2"	12.375	11.915	227.00	27.85
15"	12.750	12.290	242.00	29.40
15 1/2"	13.125	12.665	258.00	30.95
16"	13.500	13.040	274.00	32.50
16 1/2"	13.875	13.415	291.00	34.15
17"	14.250	13.790	308.00	35.80
17 1/2"	14.625	14.165	326.00	37.45
18"	15.000	14.540	344.00	39.10
18 1/2"	15.375	14.915	363.00	40.85
19"	15.750	15.290	382.00	42.60
19 1/2"	16.125	15.665	402.00	44.35
20"	16.500	16.040	422.00	46.10
20 1/2"	16.875	16.415	443.00	47.85
21"	17.250	16.790	464.00	49.60
21 1/2"	17.625	17.165	486.00	51.35
22"	18.000	17.540	508.00	53.10
22 1/2"	18.375	17.915	531.00	54.85
23"	18.750	18.290	554.00	56.60
23 1/2"	19.125	18.665	578.00	58.35
24"	19.500	19.040	602.00	60.10
24 1/2"	19.875	19.415	627.00	61.85
25"	20.250	19.790	652.00	63.60
25 1/2"	20.625	20.165	678.00	65.35
26"	21.000	20.540	704.00	67.10
26 1/2"	21.375	20.915	731.00	68.85
27"	21.750	21.290	758.00	70.60
27 1/2"	22.125	21.665	786.00	72.35
28"	22.500	22.040	814.00	74.10
28 1/2"	22.875	22.415	843.00	75.85
29"	23.250	22.790	872.00	77.60
29 1/2"	23.625	23.165	902.00	79.35
30"	24.000	23.540	932.00	81.10
30 1/2"	24.375	23.915	963.00	82.85
31"	24.750	24.290	994.00	84.60
31 1/2"	25.125	24.665	1026.00	86.35
32"	25.500	25.040	1058.00	88.10
32 1/2"	25.875	25.415	1091.00	89.85
33"	26.250	25.790	1124.00	91.60
33 1/2"	26.625	26.165	1158.00	93.35
34"	27.000	26.540	1192.00	95.10
34 1/2"	27.375	26.915	1227.00	96.85
35"	27.750	27.290	1262.00	98.60
35 1/2"	28.125	27.665	1308.00	100.35
36"	28.500	28.040	1354.00	102.10
36 1/2"	28.875	28.415	1401.00	103.85
37"	29.250	28.790	1448.00	105.60
37 1/2"	29.625	29.165	1496.00	107.35
38"	30.000	29.540	1544.00	109.10
38 1/2"	30.375	29.915	1593.00	110.85
39"	30.750	30.290	1642.00	112.60
39 1/2"	31.125	30.665	1692.00	114.35
40"	31.500	31.040	1742.00	116.10
40 1/2"	31.875	31.415	1793.00	117.85
41"	32.250	31.790	1844.00	119.60
41 1/2"	32.625	32.165	1896.00	121.35
42"	33.000	32.540	1948.00	123.10
42 1/2"	33.375	32.915	2001.00	124.85
43"	33.750	33.290	2054.00	126.60
43 1/2"	34.125	33.665	2108.00	128.35
44"	34.500	34.040	2162.00	130.10
44 1/2"	34.875	34.415	2217.00	131.85
45"	35.250	34.790	2272.00	133.60
45 1/2"	35.625	35.165	2328.00	135.35
46"	36.000	35.540	2384.00	137.10
46 1/2"	36.375	35.915	2441.00	138.85
47"	36.750	36.290	2498.00	140.60
47 1/2"	37.125	36.665	2556.00	142.35
48"	37.500	37.040	2614.00	144.10
48 1/2"	37.875	37.415	2673.00	145.85
49"	38.250	37.790	2732.00	147.60
49 1/2"	38.625	38.165	2792.00	149.35
50"	39.000	38.540	2852.00	151.10
50 1/2"	39.375	38.915	2913.00	152.85
51"	39.750	39.290	2974.00	154.60
51 1/2"	40.125	39.665	3036.00	156.35
52"	40.500	40.040	3098.00	158.10
52 1/2"	40.875	40.415	3161.00	159.85
53"	41.250	40.790	3224.00	161.60
53 1/2"	41.625	41.165	3288.00	163.35
54"	42.000	41.540	3352.00	165.10
54 1/2"	42.375	41.915	3417.00	166.85
55"	42.750	42.290	3482.00	168.60
55 1/2"	43.125	42.665	3548.00	170.35
56"	43.500	43.040	3614.00	172.10
56 1/2"	43.875	43.415	3681.00	173.85
57"	44.250	43.790	3748.00	175.60
57 1/2"	44.625	44.165	3816.00	177.35
58"	45.000	44.540	3884.00	179.10
58 1/2"	45.375	44.915	3953.00	180.85
59"	45.750	45.290	4022.00	182.60
59 1/2"	46.125	45.665	4092.00	184.35
60"	46.500	46.040	4162.00	186.10
60 1/2"	46.875	46.415	4233.00	187.85
61"	47.250	46.790	4304.00	189.60
61 1/2"	47.625	47.165	4376.00	191.35
62"	48.000	47.540	4448.00	193.10
62 1/2"	48.375	47.915	4521.00	194.85
63"	48.750	48.290	4594.00	196.60
63 1/2"	49.125	48.665	4668.00	198.35
64"	49.500	49.040	4742.00	200.10
64 1/2"	49.875	49.415	4817.00	201.85
65"	50.250	49.790	4892.00	203.60
65 1/2"	50.625	50.165	4968.00	205.35
66"	51.000	50.540	5044.00	207.10
66 1/2"	51.375	50.915	5121.00	208.85
67"	51.750	51.290	5198.00	210.60
67 1/2"	52.125	51.665	5276.00	212.35
68"	52.500	52.040	5354.00	214.10
68 1/2"	52.875	52.415	5433.00	215.85
69"	53.250	52.790	5512.00	217.60
69 1/2"	53.625	53.165	5592.00	219.35
70"	54.000	53.540	5672.00	221.10
70 1/2"	54.375	53.915	5753.00	222.85
71"	54.750	54.290	5834.00	224.60
71 1/2"	55.125	54.665	5916.00	226.35
72"	55.500	55.040	5998.00	228.10
72 1/2"	55.875	55.415	6081.00	229.85
73"	56.250	55.790	6164.00	231.60
73 1/2"	56.625	56.165	6248.00	233.35
74"	57.000	56.540	6332.00	235.10
74 1/2"	57.375	56.915	6417.00	236.85
75"	57.750	57.290	6502.00	238.60
75 1/2"	58.125	57.665	6588.00	240.35
76"	58.500	58.040	6674.00	242.10
76 1/2"	58.875	58.415	6761.00	243.85
77"	59.250	58.790	6848.00	245.60
77 1/2"	59.625	59.165	6936.00	247.35
78"	60.000	59.540	7024.00	249.10
78 1/2"	60.375	59.915	7113.00	250.85
79"	60.750	60.290	7202.00	252.60
79 1/2"	61.125	60.665	7292.00	254.35
80"	61.500	61.040	7382.00	256.10
80 1/2"	61.875	61.415	7473.00	257.85
81"	62.250	61.790	7564.00	259.60
81 1/2"	62.625	62.165	7656.00	261.35
82"	63.000	62.540	7748.00	263.10
82 1/2"	63.375	62.915	7841.00	264.85
83"	63.750	63.290	7934.00	266.60
83 1/2"	64.125	63.665	8028.00	268.35
84"	64.500	64.040	8122.00	270.10
84 1/2"	64.875	64.415	8217.00	271.85
85"	65.250	64.790	8312.00	273.60
85 1/2"	65.625	65.165	8408.00	275.35
86"	66.000	65.540	8504.00	277.10
86 1/2"	66.375	65.915	8601.00	278.85
87"	66.750	66.290	8698.00	280.60
87 1/2"	67.125	66.665	8796.00	282.35
88"	67.500	67.040	8894.00	284.10
88 1/2"	67.875	67.415	8993.00	285.85
89"	68.250	67.790	9092.00	287.60
89 1/2"	68.625	68.165	9192.00	289.35
90"	69.000	68.540	9292.00	291.10
90 1/2"	69.375	68.915	9393.00	292.85
91"	69.750	69.290	9494.00	294.60
91 1/2"	70.125	69.665	9596.00	296.35
92"	70.500	70.040	9698.00	298.10
92 1/2"	70.875	70.415	9801.00	299.85
93"	71.250	70.790	9904.00	301.60
93 1/2"	71.625	71.165	10008.00	303.35
94"	72.000	71.540	10112.00	305.10
94 1/2"	72.375	71.915	10217.00	306.85
95"	72.750	72.290	10322.00	308.60
95 1/2"	73.125	72.665	10428.00	310.35
96"	73.500	73.040	10534.00	312.10
96 1/2"	73.875	73.415	10641.00	313.85
97"	74.250	73.790	10748.00	315.60
97 1/2"	74.625	74.165	10856.00	317.35
98"	75.000	74.540	10964.00	319.10
98 1/2"	75.375	74.915	11073.00	320.85
99"	75.750	75.290	11182.00	322.60
99 1/2"	76.125	75.665	11292.00	324.35
100"	76.500	76.040	11402.00	326.10

Duoline API Size Chart and Diagram

Duoline "DL-Ring"

A unique corrosion barrier system enabling placement of GRE internal liners inside any shoulder-to-shoulder premium thread without the need for a special coupling!

THE CHALLENGE:

To provide superior internal corrosion protection using a Glass-Reinforced-Epoxy (GRE) lining system with any unmodified free-issue premium threaded tubing or casing.

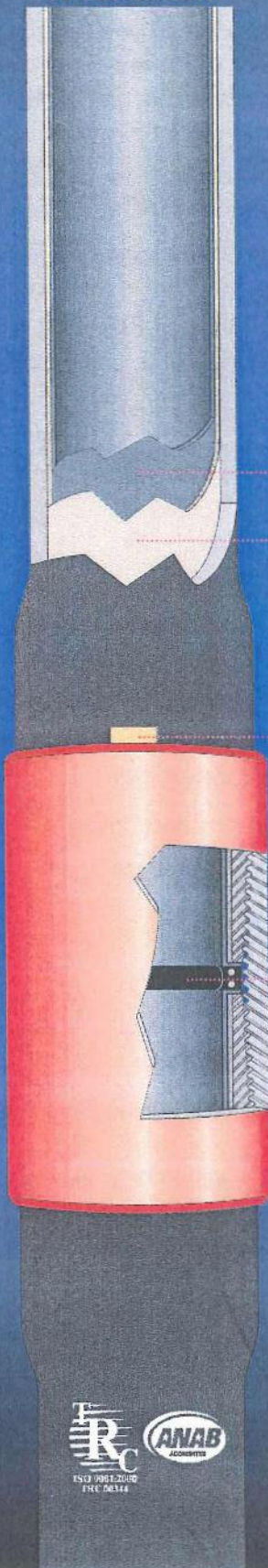
THE SOLUTION: IN TWO EFFECTIVE STEPS:

1. Use DUOLINE® from Duoline Technologies: a premium internal corrosion resistant lining system for oilfield steel tubing and line pipe. DUOLINE® is proven to be wireline abrasion and chemically corrosion resistant in both controlled laboratory testing and through successful performance in more than 75,000,000 feet of downhole application.

DUOLINE[®]
TECHNOLOGIES

Your best choice for beating the high cost of corrosion

API Connection

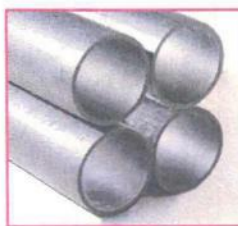


DUOLINE[®] 10-PE

(TEMPERATURE: UP TO 160°F)

DUOLINE[®] 10-PE, is a lining system which utilizes a heavy wall high density polyethylene liner and is targeted for use in specific applications for reduction of tubing corrosion in low temperature & low pressure environments.

DUOLINE[®] 10-PE is especially suited for shallow water injection well tubing where corrosive water is injected and performs within a temperature range of -20°F + 160°F.



Polyethylene Liner

Mortar

Reference Band

Corrosion Barrier Ring

Duoline Technologies[®] Furnishes Metal Reinforced Elastomer Corrosion Barrier Rings For API Connections.

DUOLINE[®] 10 BEATING THE HIGH COST OF CORROSION

DUOLINE[®] 10 is part of the unique Duoline process of inserting liner tubes into steel pipe and filling the annular space with a special cement applied with pressure. Ends are flared back so that both ends are flat and can be protected in the collar. Thus, the interior of the pipe is essentially inert to common acids and corrosive fluids.

DUOLINE[®] 10 also provides reliable joint protection. The lining is positioned on the pin and collar end of threaded pipe so that the collar is protected from corrosion when corrosion barrier rings are used.

Smoothness is ensured by the fact that the interior of the liner is unaltered during the lining process, thereby retaining the "C" factor of 150.

DUOLINE 10-PE Liner Dimensions & Weights

Pipe Size and weight/foot	PE Liner Inside Diameter Nominal, Inches	PE Liner Wall Thickness Nominal, Inches	PE Liner Recommended Drift Diameter, Inches	PE Liner Nominal Weight lbs/foot
2-7/8" 6.5 ppf	2.080"	0.135"	1.875"	0.50
3-1/2" 9.3 ppf	2.600"	0.150"	2.375"	0.80

DUOLINE[®]
TECHNOLOGIES

9019 North County Road West
Odessa, TX 79764
www.duoline.com

Phone: 432.552.9700
Fax: 432.552.9701

CONNECTION OPTIONS OVERVIEW *CONTINUED*

Benoit-BTS-FGL

- An IJ "2-step" tubing thread variation of the Benoit thread family
- Has been used in 2-1/16" through 4-1/2" pipe sizes



Nippon Steel NSCT-FGL & NSCC-FGL variations of the Nippon thread family

- Used in demanding onshore & offshore deep injection and producing wells.
- Has been used in 3-1/2" through 7" pipe sizes

Buttress Casing with Corrosion Barrier Ring & Duoline® 20

- Has been used in 4-1/2" through 9-5/8" sizes
- Used in applications where standard API Connections will not suffice and High Proprietary Connections are not feasible
- Accommodates "free-issue" unmodified threads and coupling



DUOLINE®
TECHNOLOGIES

9019 North County Road West
Odessa, TX 79764
www.duoline.com

Phone: 432.552.9700
Fax: 432.552.9701

DUOLINE®
TECHNOLOGIES

Your best choice for beating the high cost of corrosion



NEED OBJECTIVE PROOF OF PERFORMANCE? HERE IT IS:

Independent laboratory testing — combined stress loading on internally lined 5-1/2" 17 ppf VAM TOP L80 pup joints — proves that **DL-RING™** coupled with **DUOLINE®** internal lining is, "Fit for Purpose."

Specifically:

The lined casing joints were exposed to simultaneous combined bend cycling, tension/compression cycling, pressure and temperature cycling. These stress-loading steps were intended to represent loading in well conditions. Loads were based on specified test requirements and were limited to 95% of specified minimum material yield strength (SMYS) von-Mises equivalent (VME) combined load boundary limit. Tension loads were applied up to 60% of SMYS followed by compression loading up to 40% rating plus pressure application up to 7500 psig, then back to tension loading with a final rapid pressure release at 200 psi/minute. Concurrently the pipe was bent at plus and minus 10°/hundred foot radius and heated to 110° C (230° F) while sustaining pressures up to 7500 psig.

The independently verified results?

Absolutely no damage or adverse affects to the **DUOLINE®** lining system or **DL-RING™** components.



*...another great
corrosion fighter from*



9019 North County Road West
Odessa, TX 79764
www.duoline.com



Your best choice for beating the high cost of corrosion

Appendix D

Water Quality Sampling Data

Appendix D
Water Quality Sampling Data
Depth to Water Readings during Pumping Tests for
Groundwater Sample Collection

Depth of Sample Collected (feet)	Sample Date	GPM	Pumping vs. Recharge	Time of Reading	Depth to Groundwater (feet)	Conductivity (mS/cm)	Temperature (°C)
475 foot depth	9/22/2008	15	Pumping	9:30	0.00	*	19.8
		15		10:14	133.40	-	-
		15		10:15	132.70	-	-
		15		10:16	132.20	-	-
		15		10:17	131.35	-	-
		15		10:18	130.90	-	-
		15		10:19	130.35	-	-
		15		10:20	129.90	-	-
		15		10:21	129.30	-	-
		15		10:22	128.90	-	-
		15		10:23	128.45	-	-
		15		10:49	138.90	-	-
		15		10:50	138.20	-	-
		15		10:51	137.20	-	-
		15		10:52	136.60	-	-
		15		10:53	136.20	-	-
		15		10:54	135.60	-	-
		15		10:55	135.00	-	-
		15		10:56	134.60	-	-
		15		10:57	134.10	-	-
		15		10:58	133.60	-	-
		15		11:03	137.80	-	-
		15		11:04	137.40	-	-
		15		11:05	137.00	-	-
		15		11:06	136.60	-	-
		15		11:07	136.30	-	-
		15		11:08	135.50	-	-
		15		11:09	134.90	-	-
		15		11:10	134.50	-	-
		15		11:11	134.10	-	-
		15		11:12	133.60	-	-
		1,530 Gallons	Pump Off				
		0	Recharge	11:14	139.50	-	-
		0		11:19	136.10	-	-
		0		11:24	133.60	-	-
		0		11:29	131.60	-	-
		0		11:34	129.50	-	-
		0		11:37	138.70	-	-
		0		11:45	135.10	-	-

* unable to properly calibrate field water

Appendix D
Water Quality Sampling Data
Depth to Water Readings during Pumping Tests for
Groundwater Sample Collection

Depth of Sample Collected (feet)	Sample Date	GPM	Pumping vs. Recharge	Time of Reading	Depth to Groundwater (feet)	Conductivity (mS/cm)	Temperature (°C)
784 foot depth	9/25/2008	10	Pumping	3:10	-	2.41	21.9
		10		3:30	-	0.67	-
		10		3:45	-	0.97	-
		10		3:47	-	1.13	-
		10		3:52	199.00	-	-
		10		3:53	184.40	-	-
		10		3:54	180.00	-	-
		10		3:55	176.00	-	-
		10		3:56	172.20	-	-
		10		3:57	168.00	-	-
		10		3:58	162.30	-	-
		10		3:59	158.10	-	-
		10		4:00	156.30	-	-
		10		4:01	154.00	-	-
		10		4:15	-	2.12	-
		10		4:08	-	2.1	-
		10		4:11	-	2.2	-
		10		4:14	-	2.33	-
		10		4:19	-	2.9	-
		10		4:21	-	3.14	-
		10		4:24	-	3.85	-
		10		4:27	-	4.6	-
		10		4:30	-	5.66	-
		10		4:33	-	6.38	-
		10		4:35	-	7.31	-
		10		4:37	-	8.87	-
		10		4:39	-	9.79	-
		10		4:42	-	8.81	-
		10		4:44	-	8.82	-
		10		4:46	-	9.92	-
		10		4:48	-	10.42	-
		10		4:50	-	11.7	-
		10		4:52	-	12.24	-
		10		4:54	-	12.86	-
		10		4:56	-	13.5	-
		10		4:59	-	13.25	-
		10		5:02	-	14.21	-
		10		5:04	-	14.58	-
		1,140 Gallons	Pump Off				
		0	Recharge	5:49	132.00	-	-
		0		5:52	131.00	-	-
		0		5:55	130.00	-	-
		0		5:58	129.00	-	-
		0		6:02	128.00	-	-
		0		6:06	127.00	-	-
		0		6:09	127.00	-	-
		0		6:11	126.00	-	-
		0		6:13	126.00	-	-
		0		6:15	125.00	-	-
		0		6:18	125.00	-	-

Appendix D
Water Quality Sampling Data
Depth to Water Readings during Pumping Tests for
Groundwater Sample Collection

Depth of Sample Collected (feet)	Sample Date	GPM	Pumping vs. Recharge	Time of Reading	Depth to Groundwater (feet)	Conductivity (mS/cm)	Temperature (°C)
1034 foot depth	9/28/2008	20	Pumping	8:57	-	-	21.8
		20		9:00	-	1.15	-
		20		9:10	-	1.13	-
		20		9:15	-	1.13	-
		20		9:20	-	1.12	-
		20		9:30	-	1.19	-
		20		9:40	-	1.9	-
		20		9:50	-	3.17	-
		20		10:00	-	5.7	-
		20		10:10	-	10.4	-
		20		10:20	-	12.04	-
		20		10:30	-	13.02	-
		20		10:40	-	13.72	-
		20		10:50	-	14.4	-
		20		11:00	-	14.41	-
		20		11:10	-	14.81	-
		20		11:20	-	14.98	-
		2,860 Gallons	Pump Off				-
		0	Recharge	11:47	164.00	-	-
		0		11:54	162.00	-	-
		0		11:56	162.00	-	-
		0		12:00	162.00	-	-
		0		12:04	162.00	-	-
		0		12:08	162.00	-	-

Appendix E

Geotechnical Laboratory Report

BOWSER-MORNER, INC.

Delivery Address: 4518 Taylorsville Road • Dayton, Ohio 45424 Mailing Address: P. O. Box 51 • Dayton, Ohio 45401

AASHTO/ISO 17025 Accredited

LABORATORY REPORT

Report To: URS Corporation
Attn: Margaret Gilliland
One Indiana Square, Suite 2100
Indianapolis, IN 46204

Date: December 22, 2008
Report No. 411533
W.O. No. 146087
No. of Pages: 7

Report On: Laboratory Analysis of Four Rock Core Specimens

On November 26, 2008, four intervals of rock core were submitted for laboratory analysis. Specimens for permeability and density were cut from each interval using a diamond abrasion saw. Testing was performed as specified by the client and in accordance with the following procedures:

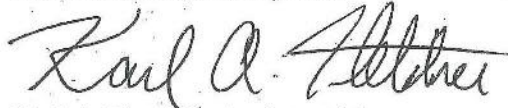
ASTM D 854, "Specific Gravity of Soils",
ASTM D 5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Parameter",
EM-1110-2-1906, "Unit Weight, Void Ratio, Porosity and Degree of Saturation (Appendix II)".

Results are summarized in Table I of the following page and detailed on the attached data sheets.

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805 extension 322.

Respectfully submitted,

BOWSER-MORNER, INC.



Karl A. Fletcher, Assistant Manager
Construction Materials and
Geotechnical Laboratories

KAF/kaf
411533
1-Client
1-File
1-Fax
1-email

Scepter Inc., Core Data Results
 Bicknell, Indiana Facility
 November 2008

for
URS Corporation

Table I - Summary of Results

Test Parameter	1543' - 1545'	1668' - 1670'	2016' - 2018'	2044' - 2046'
As Received Moisture Content, %:	0.2	0.1	0.7	1.7
Wet Unit Weight, pcf:	166.4	167.2	151.8	151.9
Dry Unit Weight, pcf:	166.1	167.0	150.7	149.4
Specific Gravity:	2.71	2.74	2.69	2.70
Void Ratio:	0.0184	0.0232	0.1139	0.1282
Volume Total (V_t), cm^3 :	196.5	196.6	195.9	197.3
Volume of Solids (V_s), cm^3 :	193.0	192.2	175.9	174.8
Volume of Voids (V_v), cm^3 :	3.5	4.4	20.0	22.5
Porosity (n), %:	1.8	2.3	10.2	11.4
Degree of Saturation, %:	34.0	8.5	16.8	35.4
Volume of Voids, %	1.8	2.3	10.2	11.4
Volume of Water, %	0.6	0.2	1.7	4.0
Volume of Solids, %	98.2	97.7	89.8	88.6
Air Filled Voids, %	66.0	91.5	83.2	64.6
Water Filled Voids, %	34.0	8.5	16.8	35.4
Permeability, cm/sec. :	5.1×10^{-10}	6.2×10^{-10}	4.9×10^{-7}	9.7×10^{-7}

URS Corporation

Table II – Detailed Sample Description

Interval Depth	Sample Description
1543' - 1545'	Limestone – brown, very fine grain, microcrystalline cement, slightly dolomitic, most grains of indeterminate origin, trace fossils observed, trace pyrite. Rock is dense with no observed pore development.
1668' – 1670'	Limestone – brown, fine to very fine grain, trace very coarse, microcrystalline cement, grains are finely broken fossils with large coral fossils replaced by chert. Rock is dense with no observed pore development.
2016' – 2018'	Limestone – gray, medium to coarse grain, microcrystalline cement, grains are ooids and fossils. Poorly developed intergranular porosity. Trace secondary calcite in pores.
2044' – 2046'	Limestone – gray, fine to coarse grain, microcrystalline cement, grains are superficial ooids and fossils. Moderately well developed intergranular porosity. Secondary calcite crystals and/or gypsum filling some pores.

FALLING HEAD PERMEABILITY TEST
ASTM D 5084, Measurement of Hydraulic Conductivity

UNDISTURBED

Client: **URS Corporation**

Project: **Rock Core Analysis**

BMI Work Order Number: **146087**

Date: **December 22, 2008**

Sample Identification: **Rock Core**

Depth, ft: **1543-1545**

Material Description: **Limestone ***

SPECIMEN DATA:

Dimension, inches
Height: **2.479**
Diameter: **2.482**

Mass, lbs: **1.155**

Moisture Content, %
Initial: **0.2**
Final: **0.5**

Wet Unit Weight, pcf
Initial: **166.4**
Final: **166.9**

Initial Dry Unit Weight, pcf: **166.1**

Back Pressure Saturation, psi
Back Pressure, Exit: **60**
Back Pressure, Enter: **63**
Lateral Pressure: **67**

Permeability (k), cm/sec: **5.1×10^{-10}**

*See attached sheet for detailed description.



**BOWSER
MORNER**

FALLING HEAD PERMEABILITY TEST
ASTM D 5084, Measurement of Hydraulic Conductivity

UNDISTURBED

Client:	URS Corporation
Project:	Rock Core Analysis
BMI Work Order Number:	146087
Date:	December 22, 2008
Sample Identification:	Rock Core
Depth, ft:	(1668-1670)
Material Description:	Limestone *

SPECIMEN DATA:

Dimension, inches	
Height:	2.478
Diameter:	2.483
Mass, lbs:	1.161
Moisture Content, %	
Initial:	0.1
Final:	0.6
Wet Unit Weight, pcf	
Initial:	167.2
Final:	168.0
Initial Dry Unit Weight, pcf:	167.0
Back Pressure Saturation, psi	
Back Pressure, Exit:	90
Back Pressure, Enter:	93
Lateral Pressure:	97

Permeability (k), cm/sec: 6.2×10^{-10}

*See attached sheet for detailed description.



**BOWSER
MÖRNER**

FALLING HEAD PERMEABILITY TEST
ASTM D 5084, Measurement of Hydraulic Conductivity

UNDISTURBED

Client:	URS Corporation
Project:	Rock Core Analysis
BMI Work Order Number:	146087
Date:	December 22, 2008
Sample Identification:	Rock Core
Depth, ft:	(2016-2018)
Material Description:	Limestone *

SPECIMEN DATA:

Dimension, inches	
Height:	2.473
Diameter:	2.481
Mass, lbs:	1.050
Moisture Content, %	
Initial:	0.7
Final:	3.9
Wet Unit Weight, pcf	
Initial:	151.8
Final:	156.6
Initial Dry Unit Weight, pcf:	150.7
Back Pressure Saturation, psi	
Back Pressure, Exit:	80
Back Pressure, Enter:	83
Lateral Pressure:	87

Permeability (k), cm/sec: 4.9×10^{-7}

*See attached sheet for detailed description.



**BOWSER
MORNER**

9-26-08

7:00 Arrive on site

7:00 Core from Westway 11

77th Core Down to 794

Core is 10ft long

material is shale w/ 11 inches of sandstone

65" of Fracturing 45.8% P&Q

78th Core Down to 804

Core is 10ft long

material is shale & sandstone

72" of Fracturing 81.6% P&Q

79th Core Down to 814

Core is 10ft long

material is Sandstone

79" of Fracturing 34% P&Q

80th Core Down to 824ft

Core is 10ft long

Sandstone material

17" of Fracturing 95.8% P&Q

8:30 81st Core Down to 834

Core is 10ft long

material is Sandstone

2" of Fracturing 98.3% P&Q

10:30 82nd Core Down to 844.3

Core is 10ft 4" long

material is Sandstone

8" of Fracturing 93.5% P&Q

12:40 83rd Core Down to 854.6

Core is 10ft 4" long

material is Sandstone

27" of Fracturing 87.2% P&Q

material is not detected

2:30 84th Core Down to 854.7

Core is 10ft 2"

material is Sandstone

3" of Fracturing 97.5% P&Q

4:20 85th Core Down to 875ft

Core is 10ft long

material is Sandstone

27" of Fracturing 77.5% P&Q

6:05 Depart

7th core Down to 744ft

Core is 10ft 3" long
material is Delinquent shale
17" of Finishing 31.1% RAO

7th core Down to 754ft

Core is 10ft 1" long
material is shale w/ 13" of coal. No more shale & Delinquent
29" of Finishing 75.8% RAO

7th core Down to 764ft

Core is 10ft 1" long
material is shale
4" of Finishing 94.6% RAO

7:05 Drill. Down to 764ft last night

We should take a water sample now
But Pump has not arrived yet
It should be here by Noon

9:00 7th core Down to 774.2ft

Core is 10ft 2" long
material is shale
22" of Finishing 71.9% RAO

11:30 7th core Down to 784ft

Core is 10ft long
material is shale
32" of Finishing 73.3% RAO

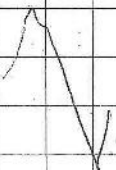
1:00 Pump arrives with tender

its a Day take
Drill Depart Depth is 784

3:00 Began water sampling

6:45 Finish water sampling

7:00 Depart



9-24-08

weather 85° sunny

7:00 Arrive site

8 Cores From last night

57th Core Down to 591^{ft}

Core is 10ft long

material is Sandstone w/ coal veins

0" Fracturing 100% RQD

58th Core Down to 601^{ft}

Core is 10ft long

material is Sandstone

0" Fracturing 100% RQD

59th Core Down to 611^{ft}

Core is 10ft long

material is shale

72" of Fracturing 40% RQD

60th Core Down to 621^{ft}

Core is 10ft long

material is shale

13" of Fracturing 79.1% RQD

61st Core Down to 631^{ft}

Core is 10ft long

material is shale & sandstone at bottom 19"

16" of Fracturing 86.6% RQD

62nd Core Down to 641^{ft}

Core is 10ft long

material is Sandstone & shale (see #1)

shale has stripes of sandstone (tiger stripes)

76" of Fracturing 36.6% RQD

63rd Core Down to 651^{ft}

Core is 10ft long

material is shale and sandstone layers together

1.4% tiger stripes

74" of Fracturing 38.3% RQD

64th Core Down to 661^{ft}

Core is 10ft long

material is Sandstone

39" of Fracturing 67.5% RQD

9-23-08

weather:

6:50 am we start

5 cores from last night

47th core down to 4936 ft

core is 8' 0" 16" low 2

core got sand in bed

material is 2nd shale 10" cont

18" of finishing 87.3% RAO

46th core down to 5026

core is 8' 0" 16" long

core got sand in bed

material is dolomite in shale, 34" of coal

then dolomite

58" of finishing 43% RAO

45th core down to 5136 ft

core is 10' 0" 16"

material is shale then 10" of coal then

dolomite & sandstone

14" of finishing 38.8% RAO

1:30 Begin Drilling

Small, no. 12 non-soluble

2:45 46th core down to 4185

core is 10' 0" 16"

material is shale - has 130 rows of fossils

6" of finishing 17.6% RAO

3:00 call Dave to replace equipment

3:45 Bart pulling rods to replace bit

4:00 Departing to ship equipment to site

4:30 Shipping equipment

5:00 Depart

9-22-08

weather 80° sunny

7:00 arrive onsite

9 core's were drilled last night

37th core Down to 393.5

core is 8.5^{ft} long core got blocked

soil is short

material is Sandstone

NO Fracturing ~~for~~ 100% RQD

38th core Down to 404

core is 10.5^{ft} long

material is Sandstone

NO Fracturing 100% RQD

39th core Down to 414.3

core is 10.3^{ft} long

material is Sandstone & shale

17" of Fracturing 86.1% RQD

40th core Down to 424

core is 10^{ft} long

material is shale

28" of Fracturing 76.6% RQD

41st core Down to 434^{ft}

core is 10^{ft} long

material is 30" of shale 20" of coal

then shale and limestone

29" of Fracturing 75.8% RQD

42nd core Down to 444^{ft}

core is 10^{ft} long

material is Sandstone and limestone

and 6" of ~~shale~~ coal

15" of Fracturing 87.5% RQD

43rd core Down to 454.3^{ft}

core is 10^{ft} long

material is 10" coal then shale & sandstone

29" of Fracturing 75.8% RQD

44th core Down to 464.6^{ft}

core is 10^{ft} long

material is shale

11" of Fracturing 90.8% RQD

45th core is Down to 475

core is 10^{ft} long

material is shale

17" of Fracturing 85.8% RQD

we will use the Pond water until
Scripser can get use water on Monday
will hold off on water sample till Monday
for magnetic
5:00 Boat will install Blow out preventer
and Rig up pump to pump Pond water
Then continue Drilling
Depart

9-21-08

Weather 75° Rainy

7:00 Arrive on site

Blow out Preventer installed
Night crew Drilled to 325ft

25th Core Down to 275ft

Core is 10ft long

material is shale and limestone

14" of Fracturing 88.3% PQD

26th Core Down to 274.6ft

Core is 9.5ft long

material is shale & limestone

6" of Fracturing 94.7% PQD

27th Core Down to 294.8

Core is 10.5ft long

material is shale & limestone

5" of Fracturing 96% PQD

28th Core Down to 304ft

Core is 9ft long

material is shale and 3.5" of calc. ^{1st} part

6" of Fracturing 94.4% PQD

9-17-08

weather 78° sunny

7:00 arrive cable

2ND shift got Down to

142⁵ ft last night

still remaining out hole today

8:00 Boat pulling Reels out of hole

B.T.'s not cutting correctly

They are going to check it

8:45 Change Drill B.T. and

start Drilling again

12:45 162⁵ ft Down

multimeter is now defect

5:00 197⁵ ft Down

7:00 209⁵ ft

Depart

9-18-08

weather

7:00 arrive cable

multimeter now it to 2-18 ft

Continue Drilling

8:20 magnet arrives

doors what has happened

This week to log Borings

9:30 Paul & shops by to

see how things are going

12:30 Reel 25⁵ ft

1:00 Begins pulling Casing Back

out of ground to retrieve B.T.

2:00 Pull Final Casing out

B.T. has been total magnet

hole of B.T. is gone and

still down in the hole

3:00 Boat is going to make

Apiece to risk the B.T. out of the hole

> multimeter now defect

5:00 still working on getting B.T. out

7:00 still working

9:00 " "

12:00 " "

9-15-08

weather: 75° cloudy

7:00 Arrive on site (Borak waste)

7:30 Begin Drilling NEED OVERSIGHTS
EODIC/STAMP

7:00 Don Limbach From DNR

ARRIVES

wants to know when we will

be plugging hole and when

we do he wants to be here at

least 2:45 and up

9:00 16th Core Down to 185ft

Core is 10ft long

material is Sandstone

Finishing = 19" 100% RAD

10:15 17th Core Down to 195ft

Core is 10ft long

material is Sandstone

Finishing = About 26" 100% RAD

11:25 18th Core Down to 205ft

Core is 10ft long

material is Sandstone

Finishing = 4" 96.6% RAD

1:25 19th Core Down to 215ft

Core is 10ft long

material is 2.5ft Sandstone

1ft shale 2.5ft coal 1/2" 4ft shale

Coal has Iron Pyrite

27" of Finishing 77.5% RAD

2:40 20th Core Down to 225ft

Core is 10ft long

material is Limestone & Dolomite

No Finishing 26" 100% RAD

4:00 21st Core Down to 235ft

Core is 10ft long

material is Sandstone & shale

No Finishing 26" 100% RAD

5:25 22nd Core Down to 245ft

Core is 10ft long

material is shale w/last 1ft coal

No Finishing 26" 100% RAD

5:30 Depart

9-13-08

weather - 87.5° sunny

7:00	arrive onsite	
7:20	2 trucks of water Delivered	
7:25	Boat Arrives	
9:00	23 rd Down	
9:30	27 th Down	
	Placed First casing 27 th ft	
	Beginning of Bed rock	
	Shifting smaller casing with	
	Diamond Bit to go to 250 th	
11:00	Began Drilling cores	
1:00	First core Down to 35 th	
	- Core is 51" long (41 st 3 rd in)	
	material is shale	
	NO Fracturing 20% = 100% RAD	
2:00	NO Detected Readings from multi meter	
2:30	2 nd core Down to 45 th	
	- Core is 10 th long	
	material is shale	
	NO Fracturing 20% = 100% RAD	
4:00	3 rd core Down to 55 th	
	- Core is 10 th long	
	material is shale	
	NO Fracturing 20% = 100% RAD	
5:00	Depart	

9-14-08

weather - 75° Cloudy

8:00	arrive onsite	Boat on site
	2 cores from last evening are	
	And out	
4 th	core Down to 65 th	last 45 th ft
	core is 10 th long	material is shale-coal
	Fracture = none	Rad 20% RAD
9 th	core Down to 75 th	
	core is 8.5 th long	material is shale
	Some of the core slipped out of	
	the Rods and has to be re-drilled	
	So it is a Bit more - 10 th	
	23 rd of Fracturing	70% RAD
9:45	1 st core Down to 85 th	
	core is 10 th long	
	material is shale sandstone	
	NO Fracturing 20% = 100% RAD	
10:40	7 th core Down to 95 th	
	core is 10 th long	
	material is shale sandstone	
	NO Fracturing 20% = 100% RAD	
11:00	Starts Rain	

9-17-08

7:00 Arrive on site

7 cores from last night

86th core Down to 885ft

Core is 10ft long
material is Sandstone
12" of Fracturing 90% RQD

87th core Down to 895ft

Core is 10ft long
material is Sandstone
8" of Fracturing 93.3% RQD

88th core Down to 905ft

Core is 10ft long
material is Sandstone
7" of Fracturing 94.1% RQD

89th core Down to 915ft

Core is 10ft long
material is Sandstone
27" of Fracturing 77.5% RQD

90th core Down to 925ft

Core is 10ft long
material is Sandstone
8" of Fracturing 93.3% RQD

91st core Down to 935ft

Core is 10ft long
material is Sandstone
No Fracturing < 6" 100% RQD

92nd core Down to 945ft

Core is 10ft long
material is Sandstone
7" of Fracturing 93.3% RQD

93rd core Down to 954ft

Core is 9ft long 1st sl. of clay / rather
material is Sandstone and shale
34" of Fracturing 68.5% RQD

94th core Down to 963ft

Core is 9ft long
material is shale
16" of Fracturing 85.1% RQD

7:30 Flush core with water

8:30 start water sampling

Water Sample

1034ft Down

used Pond water to flush hole

Pump - Around 270^{ft} Deep

4" DIAM ROD

* Start pump 8:57

ROD 13^{ft} off Bottom

COND

TANK COND - .85 = pond water

MUD COND - 2.60

9:00 = 1.15

9:10 = 1.13

9:15 = 1.13

9:20 = 1.12

temp 71.4

9:30 = 1.17

9:40 = 1.90

9:50 = 3.17

10:00 = 5.70

10:10 = 10.40

10:20 = 12.04

10:30 = 13.02

10:40 = 13.72

Flow = 5 gal - 16 sec

10:50 = 14.40

11:00 = 14.11

11:10 = 14.81

11:20 = 14.98 - Sample * STH - 1 1034^{ft}

↑ Stop - Remove pump
Man check Per large

Recharge

11:47 - 164'

11:54 - 162'

11:56 - 162'

12:00 - 162'

12:01 - 162'

12:08 - 162'

101st core Down to 1034

core is 10ft long

material is shale

74" of Fracturing 38.3% RQD

- Multi meter is now dead

3:00 core Down to 1044^{ft}

core is 10ft long

material is shale than sandstone

144" of Fracturing 88.3% RQD

3:30 Set everything up for Nathan Hyde
of URS to talk over on Monday

4:00 Depart

9-29-08

11:05 - Sceptor truck on-site to pick up water tanks

11:55 - Truck back on-site, delivering 2 tanks of water

Note: multi-meter has low battery, will have to charge tonight at the hotel

~~2:40~~

2:10 - John Limbach on-site, seeing how things are going

2:40 - Sceptor picked up empty water tanks
- Resume drilling

3:10 - Water delivered

3:25 - Maggie Depart site

3:50 - Pulled core from 1,124' (110th)
10 ft core length
10" fracturing 91.7% RQD
sandstone

4:05 - took pics of cores (wide range)

5:00 - DEPART

9-30-08

Personnel: D. Hyde, Weather: 55-65°, foggy

7:30 - Arrived on-site, Boart drilling

5 cores layed out, down to 1,174 ft.
since last departed

110th Core down to 1,134 ft.

core is 10' in length

1" of fracturing, 99.2% RQD

111th Core down to 1,144 ft.

core is 10' in length

25" of fracturing, 79.2% RQD

112th core down to 1,154 ft.

Core is 10' in length, shale & sandstone

52" of fracturing, 56.7% RQD

113th Core down to 1,164 ft.

Core is 10' in length, ~~56.7% RQD~~ shale

47.5" of fracturing, 60.4% RQD

114th Core down to 1,174 ft.

Core is 10' in length, limestone & shale

24.5" of fracturing, 79.6% RQD

10-1-08

Personal: Parker Hyde (JRS), Ronnie & Wayne (Boart)
Weather: 47°-65°

7:30 - Arrive on-site

3 cores layed out since last on-site

- Down to 1,234 ft

18th Core, down to 1,214 ft

Core is 10' in length

Material is shale

91.5" of fracturing, 23.75% RAD

19th Core down to 1,224 ft

Core is ~~shale~~ (will)

Material is shale

82" of fracturing, 31.7% RAD

20th Core down to 1,234 ft

Core is 10' in length

23" of fracturing, 80.8% RAD

(JRH)

10-1-08

7:40 - Spoke w/ Ronnie about depth, have hit a hard & heavy material, believed to possibly be the sandstone unit desired
1230

for a stopping point. Called Maggie and described progress, told her we will want to take water sample today since we wouldn't be able to get water if drilling finished today. Maggie says her and Dave will come down, Boart will flush and prep the hole for sampling

8:10 - Spoke w/ Ronnie, says material is not the desired stopping point, per (JRH)

(Boart), looking for better sandstone, while in color and hard. Says looking for that material as a hard setting point to prevent any shifting. Says will finish current drive then flush the hole and have it ready for sampling upon arrival of Maggie and Dave C.

9:30 - Pulled 121st core down to 1,244 ft

Core is 10' in length

13" of fracturing, 89.2% RAD

10-1-08

(MAY 100)

3:00 9:40

3:10 9:54

3:20 9:55

3:30 9:59

3:40 10:23

3:50 10:59

4:00 10:45

4:10 11:07 Flow 5 gal in 11 sec

4:15 11:28

4:20 - STOPPED PUMP *NO Sample taken*

4:22 - Placed water level measure tape down 202' bgs.

4:27

WL

4:35 202'

4:40 170'

4:40 164'

4:50 - Water level tape getting stuck & unable to get to water.

4:55 Pulled pump and cable out it was limited

5:40 Depart

10-9-08

Arrived on site 8:15 am
 Bart Longman former Wayne
 on site

DES/ Diane on site

Set up vac truck ~~with~~ ⁴⁶
 north of pit

Backhoe not going to be
 here until ~~thru~~
 afternoon. Will see
 what we can do without
 mixing it up.

Walking here
 125 yards from the first
 pit

Tom Keadar called. Needs
 set depth to water
 in biohazard.
 Cans soon as the blow out
 phenomena can be removed
 we will collect depth

125th core Down to 1284^{ft}

core is 10^{ft} long

material is sandstone

0" of Fracturing 100% RQD

126th core Down to 1294^{ft}

core is 10^{ft} long

material is sandstone

3" of Fracturing 97.5% RQD

127th core Down to 1304^{ft}

core is 10^{ft} long

material is sandstone

0" of Fracturing 100% RQD

128th core Down to 1314^{ft}

core is 10^{ft} long

0" of Fracturing 100% RQD

material is sandstone

129th core Down to 1324^{ft}

core is 10^{ft} long

material is sandstone

0" of Fracturing 100% RQD

130th core Down to 1330^{ft}

core is 6^{ft} long

material is sandstone

14" of Fracturing 80.5% RQD

Boart has set 4.5" HW at 1330^{ft}

Now using 3⁷/₈" ~~HC~~ ^{HC} in 15^{ft} runs

New BOP installed yesterday to
fit new HQ rods

9:15 131st core Down to 1345^{ft}

core is 10^{ft} long

material is sandstone & limestone

23" of Fracturing 87.2% RQD

2:15 132nd core Down to 1360^{ft}

core is 15^{ft} long

material is shale & dolomite (green color)

35" of Fracturing 52.7% RQD

7:00
138th core Down to 1450^{ft}
core is 15^{ft} long
material is Limestone
4" of Fracturing 97.7% RQD

11:15 139th core Down to 1465^{ft}
core is 15^{ft} long
material is Limestone & Dolomite
4" of Fracturing 97.7% RQD

1:35 140th core Down to ~~1470~~ 1475^{ft}
core is 13^{ft} long 2nd slipped out of Bottom
material is Limestone
0" of Fracturing 100% RQD

3:50 141st core Down to 1494^{ft}
core is 16^{ft} long
material is Limestone
0" of Fracturing 100% RQD

5:00 Depart

10-12-08

Weather: 85° sunny

7:00 arrive onsite

5 Cores From last night

142nd core Down to 1510^{ft}
core is 16^{ft} long
material is Limestone
10" of Fracturing 94.7% RQD

143rd core Down to 1525^{ft}
core is 15^{ft} long
material is Limestone
0" of Fracturing 100% RQD

144th core Down to 1540^{ft}
core is 15^{ft} long
material is Limestone w/ small Quartz seen @ 1530^{ft}
0" of Fracturing 100% RQD

145th core Down to 1555^{ft}
core is 15^{ft} long
material is Limestone
3" of Fracturing 98.3% RQD

10-13-08

weather 75° overcast

6 cores from Lastnight

151st core down to 1645^{ft}

core is 15^{ft} long

material is limestone w/ quartz

0" of Fracturing 100% RQD

152nd core down to 1660^{ft}

core is 15^{ft} long

material is limestone w/ quartz

0" of Fracturing 100% RQD

153rd core down to 1675^{ft}

core is 15^{ft} long

material is limestone w/ quartz

2" of Fracturing 98.8% RQD

154th core down to 1690^{ft}

core is 15^{ft} long

material is limestone w/ quartz

4" of Fracturing 97.7% RQD

155th core down to 1705^{ft}

core is 15^{ft} long

material is limestone w/ quartz

5" of Fracturing 97.7% RQD

156th core down to 1720^{ft}

core is 15^{ft} long

material is limestone w/ quartz

7" of Fracturing 98.8% RQD

157th core down to 1735^{ft}

core is 15^{ft} long

material is limestone w/ quartz

8" of Fracturing 100% RQD

158th core down to 1750^{ft}

core is 15^{ft} long

material is limestone w/ quartz

0" of Fracturing 100% RQD

2:00 P. core & mike stop By

164 core Down to 1838^{ft}
 Core is 13^{ft} long some of put out bottom
 material is Limestone / ~~some of~~ some of large Quartz
 0" of Fracturing 100% RAD

1650 165th core Down to 1853.5^{ft}
 Core is 15.5^{ft} long
 material Limestone / ~~some of~~ some of large Quartz
 3" of Fracturing 98.3% RAD

8:00 Pump Breaks / Mix mud
 Boat Fixing

10:30 start Drilling Again

12:30 166th core Down to 1870^{ft}
 Core is 11.5^{ft} long some of put out bottom
 material is Limestone / ~~some of~~ some of large Quartz
 0" of Fracturing 100% RAD

3:20 167th core Down to 1885^{ft}
 Core is 15^{ft} long
 material is Limestone / ~~some of~~ some of large Quartz
 4" of Fracturing 97.7% RAD

3:35 Pirouz stops Dr

5:00 168th core Down to 1900^{ft}
 Core is 15^{ft} long
 material is Limestone / ~~some of~~ some of large Quartz
 8" of Fracturing 95.5% RAD

5:15 Depart

10-16-08

Weather: 60° cloudy
7:00 Arrive

4 cores from last night

178th core Down to 2050

core is 15^{ft} long
material is Limestone
0" of Fracturing 100% RQD

179th core Down to 2065

core is 15^{ft} long
material is Limestone
0" of Fracturing 100% RQD

180th core Down to 2080^{ft}

core is 15^{ft} long
material is Limestone
4" of Fracturing 97.7% RQD

181st core Down to 2091

core is 11^{ft} long (Rig Broke last night)
material is Limestone
0" of Fracturing 100% RQD

10:00 182nd core Down to 2100^{ft}

core is 9^{ft} long (short log + back to)
material is Limestone
10" of Fracturing 90.7% RQD

12:40 183rd core Down to 2115^{ft}

core is 15^{ft} long
material is Limestone
4" of Fracturing 97.7% RQD

2:30 184th core Down to 2130^{ft}

core is 15^{ft} long
~~2" of Fracturing~~ material is Limestone
2" of Fracturing 98.8% RQD

3:30 Talk to Maggie about Parker test
and talk to John about Parker test
will perform first test at 8:00 tomorrow

4:50 185th core Down to 2145^{ft}

core is 15^{ft} long
material is Limestone w/ shale @ 2140
5" of Fracturing 97.2% RQD

5:10 Depart

3:00 Formation is Beginning
to Take A lot of water
need more water Talking w/ Pirouz
to get water

4:00 Come get tanks

5:00 Drop tanks off

5:20 Call Pirouz Because we will need
water Sunday morning He says
He will try his Best.

5:35 190th core Down to 2220^{ft}
core is 15^{ft} long
material is limestone
4" of Fracturing

6:00 Depart

10-19-08

7:00 Arrive on site

Boat is out of water Formation
is taking all the water which
is stopping circulation might shut
stopped at 2:30
trying to get a hold of someone
For water

9:00 call Pirouz leave message

9:20 Pirouz calls Back He says He will
get someone here as soon as possible

11:00 truck Picks up tanks

11:30 TALK to Maggie About water situation

11:55 2 water tanks Delivered
Start mixing mud

2 cores from last night

191st core Down to 2235^{ft}

core is 15^{ft} long

material is limestone

4" of Fracturing 97.7% RQD

WL = 8.55 to top of BOP
Bop is 2^{ft} Above GL
WL = 6.55 ~~at~~ Below Ground level

1:00 Tom Arrives

Test 1 2230 - 2285 10 gal & 30 gal (5 min interval)
2 2175 - 2285 10, 20, 30 gal (5 min intervals)

3:00 Maggie Departs

3:30 start test 1 4:00 Tom Departs

5:00 Finish test 1

5:50 start test 2

7:45 Finish test 2

* Dome coring, core is 2285 ft deep

8:00 Depart

10-21-08

weather: sunny

7:00 Arrive on site

Boat is getting cement

8:00 water truck picks up tanks

9:00 Drop off single tank

10:30 Logger calls says he will

Be here at 3:00 instead of 12:00

11:00 Boat has tank here picking
up extra Rops & supplies

2:50 Talk to Maggie about status of Hole

3:00 call Don Limbach about cementing
Hole I give him the status of
where we are now. He says
he needs to be here for the
whole 1500 ft and he will be
available Friday at 7:00

4:00 E loggers will be later

5:30 E loggers still will be later

7:00 E loggers are on their way

8:00 E loggers Arrive (weatherford sensors)

Begin setup & Log

11:00 E loggers Depart

11:15 Depart

10-23-08

7:00 Arrive on-site

Talked to Tom last night I will try to find someone to contact regarding the case

8:00 Called Wayne County Services

they have what we need But I need talk to Danny But he will not be until the morning, I'll call Don Limbach

8:30 Call Don Limbach to discuss

situation He will be at site

Around 1:30

11:30 Danny from Wayne County calls

to over what we need done and when they can do it and how much it will cost.

11:45 talk to Maggie I give her Wayne County info so she can give it to Tom

12:20 talk to Danny he went over things w/ Tom scheduled for 9:00 tomorrow

3:00 Don Limbach on site

to over procedures
He thinks we will be alright

4:05 Don Departs

5:00 Depart

10/25/08

weather 60° windy/sunny

7:30 Arrive

Cutler arrived last night
will use it to cut 1200 ft
645 ft

8:30 IZON says he heard a snap
when he put tension on the rods
and they came loose
we will see how many we can
take out

1:50 All 655 ft of Red came out
it was cut were Wayne County cut it
yesterday we also can see the perforation

2:00 Call Tom let him know

2:20 Call Don Limbach setup
time for Cement at 9:00 Monday

3:00 Beart will insert rods to top
Cement

4:15 Depart

10/26/08

12:00 Beart calls and says
they could not tag the cement plug
went down 1700 ft. plug ~~was~~
should have been set at 1500 ft

11:40 Call Tom to discuss he will
call Bill Dikus at Beart

2:00 Tom calls and says that
Beart will take a few days off
then come back with a new
type of plug

2:30 Call Don Limbach to tell
him we will be delayed

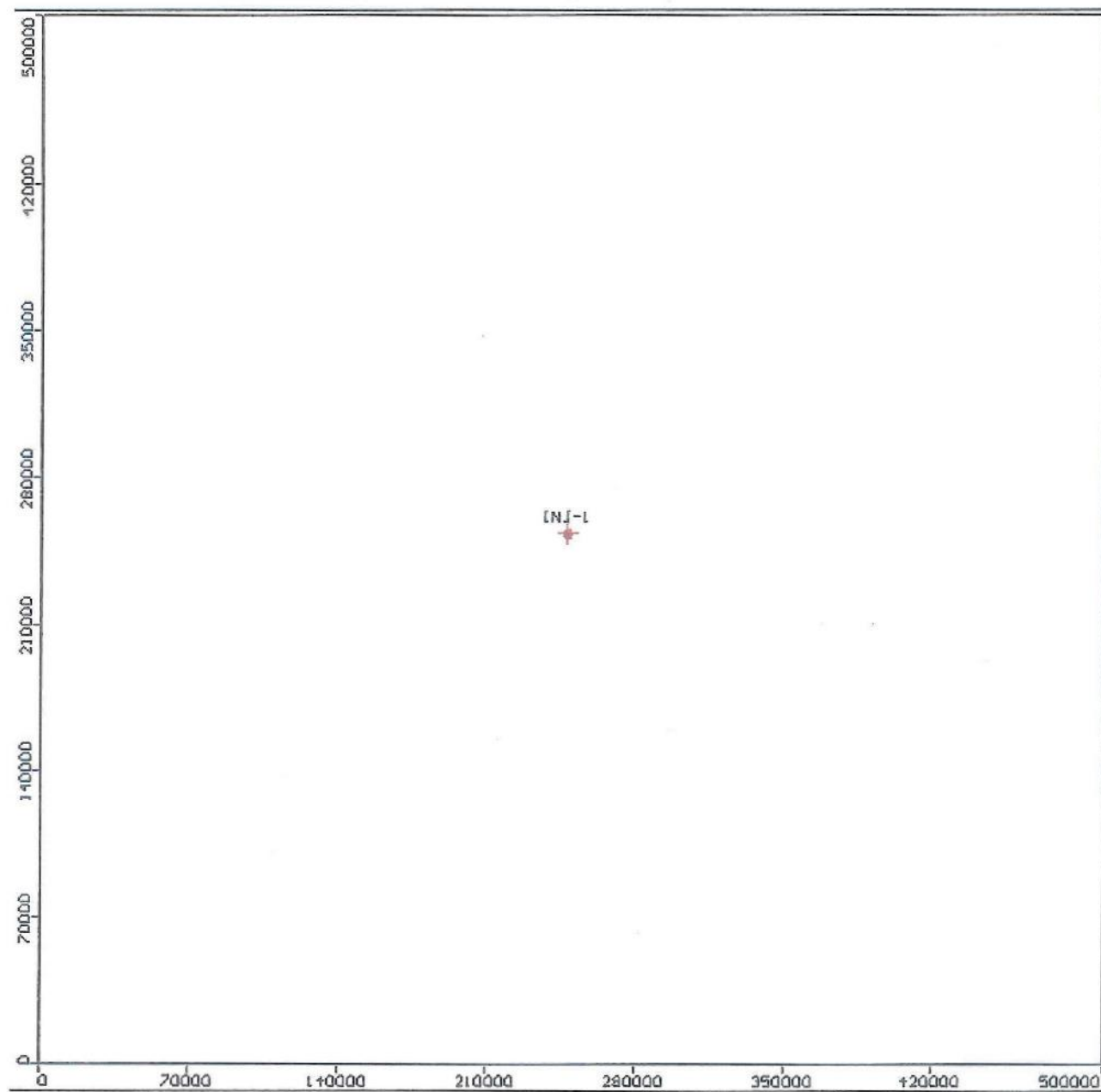
- 25 1244
26 Cores Down to 1244
27 Cores Down to 1330^{ft}
28 Green shale 1370^{ft}
29 Limestone w/ Quartz seam @ 1536^{ft}
30 Limestone w/ Quartz 1770^{ft}
31 Limestone w/ Gypsum seam @ 1975^{ft}
(32) 32 Limestone w/ solution Fracture @ 1973^{ft}
34 Limestone w/ calc. Deposit @ 2140
35 Hook wall Packer
36 Packer Test - Gauges and Unlogs
37 Packer (Hook wall)
38 Packer (Hook wall)
39 Packer (Hook wall)
40 Rods Perforated
41 Rod End Cut

Appendix H

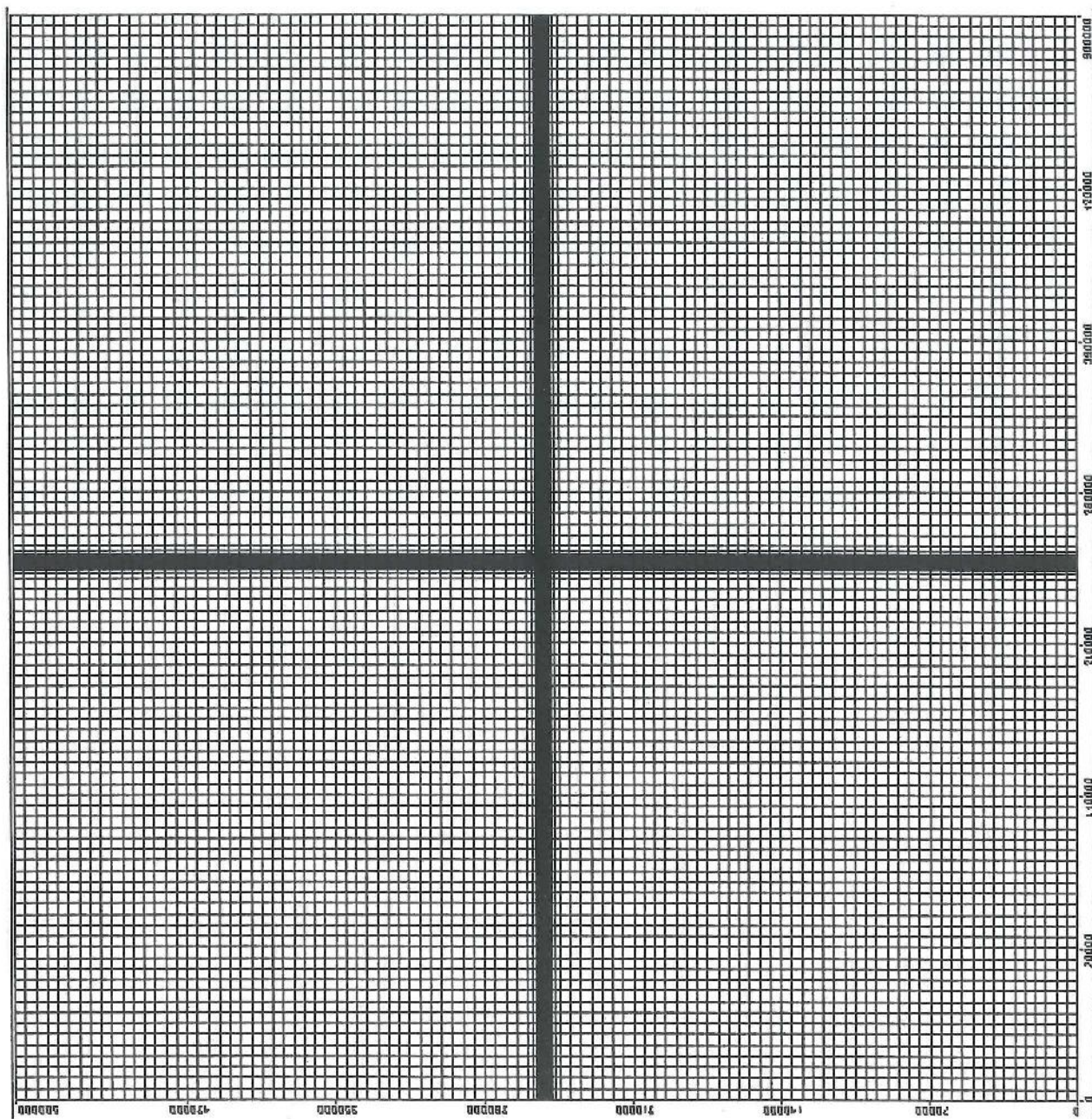
Copy of Bore Hole Geophysical Logs

Appendix I

Area of Influence (AOI) Pumping Rate vs. Distance



Model Area



Model Grid

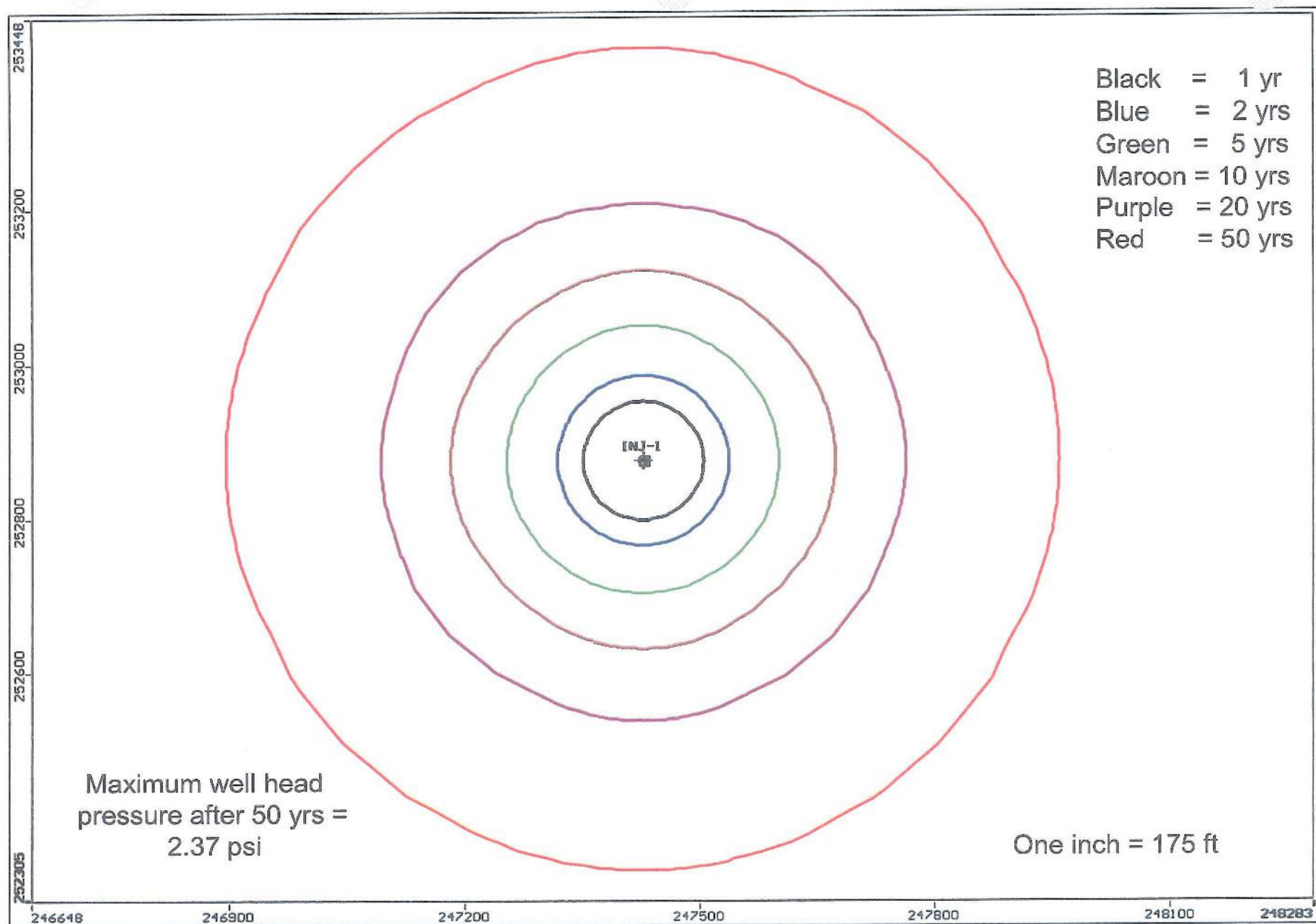


Figure 3 -- Contours of 1 psi for rate of 1 gpm for various periods of injection.

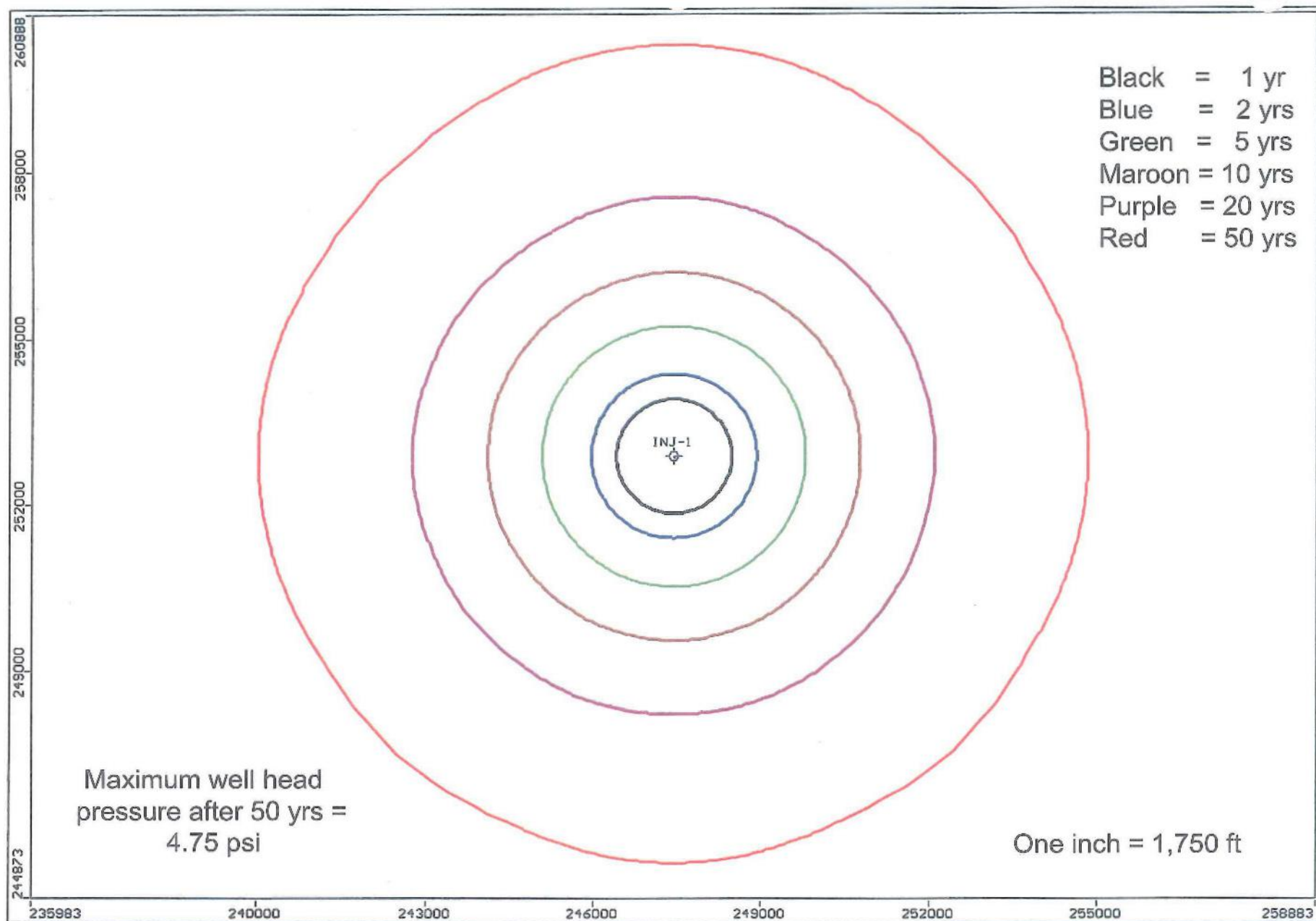


Figure 4 -- Contours of 1 psi for rate of 2 gpm for various periods of injection.

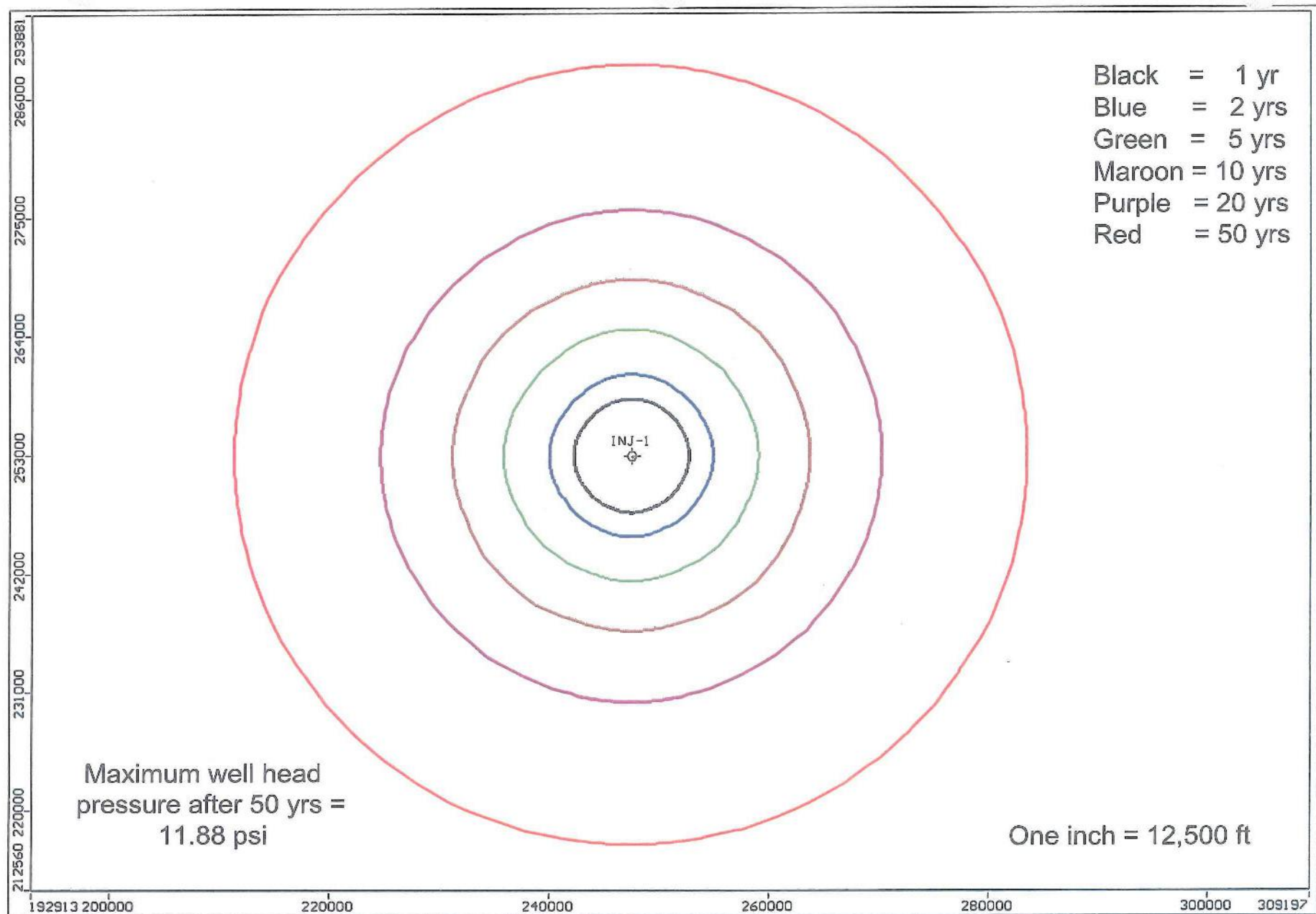


Figure 5 -- Contours of 1 psi for rate of 5 gpm for various periods of injection.

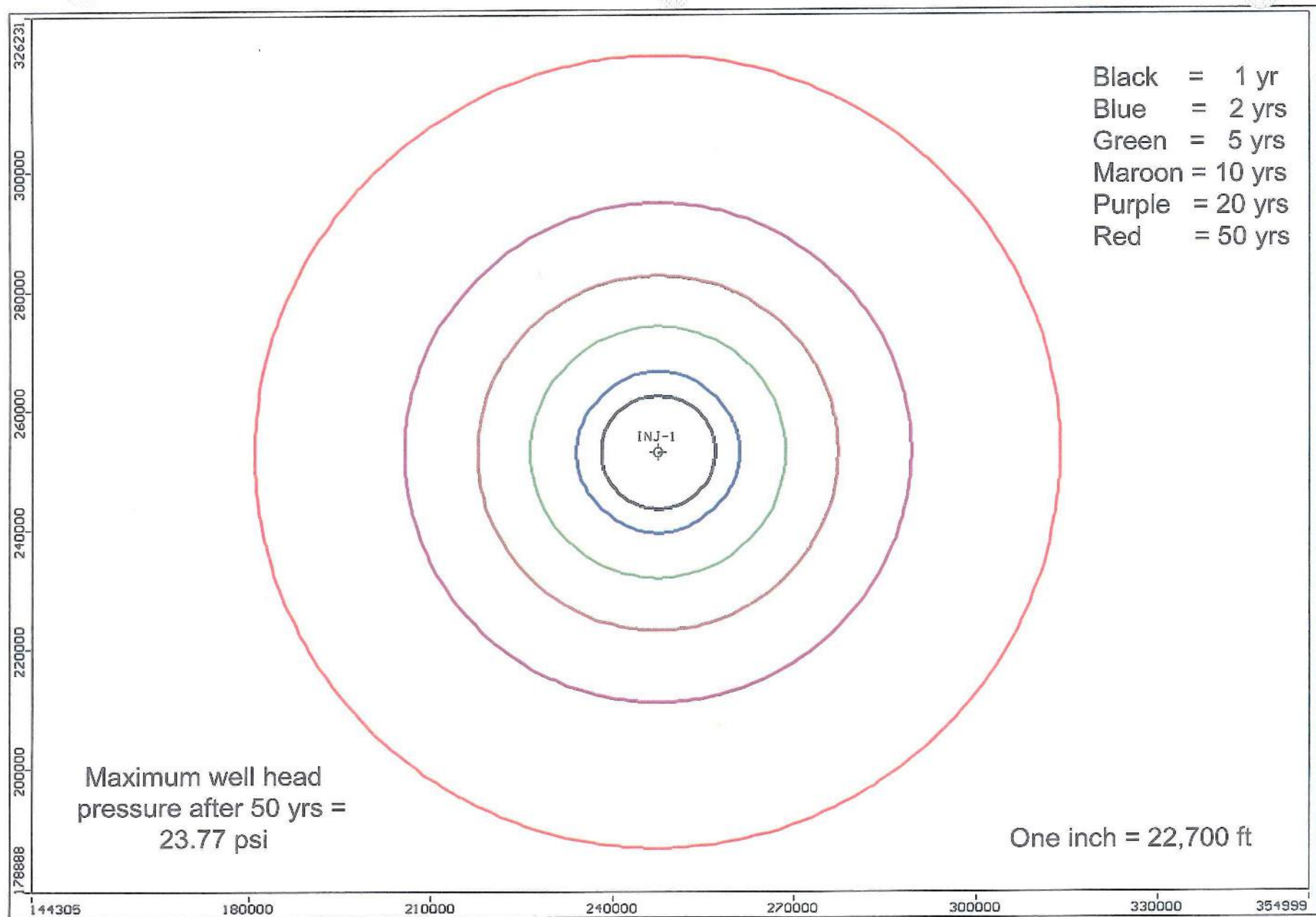


Figure 6 -- Contours of 1 psi for rate of 10 gpm for various periods of injection.

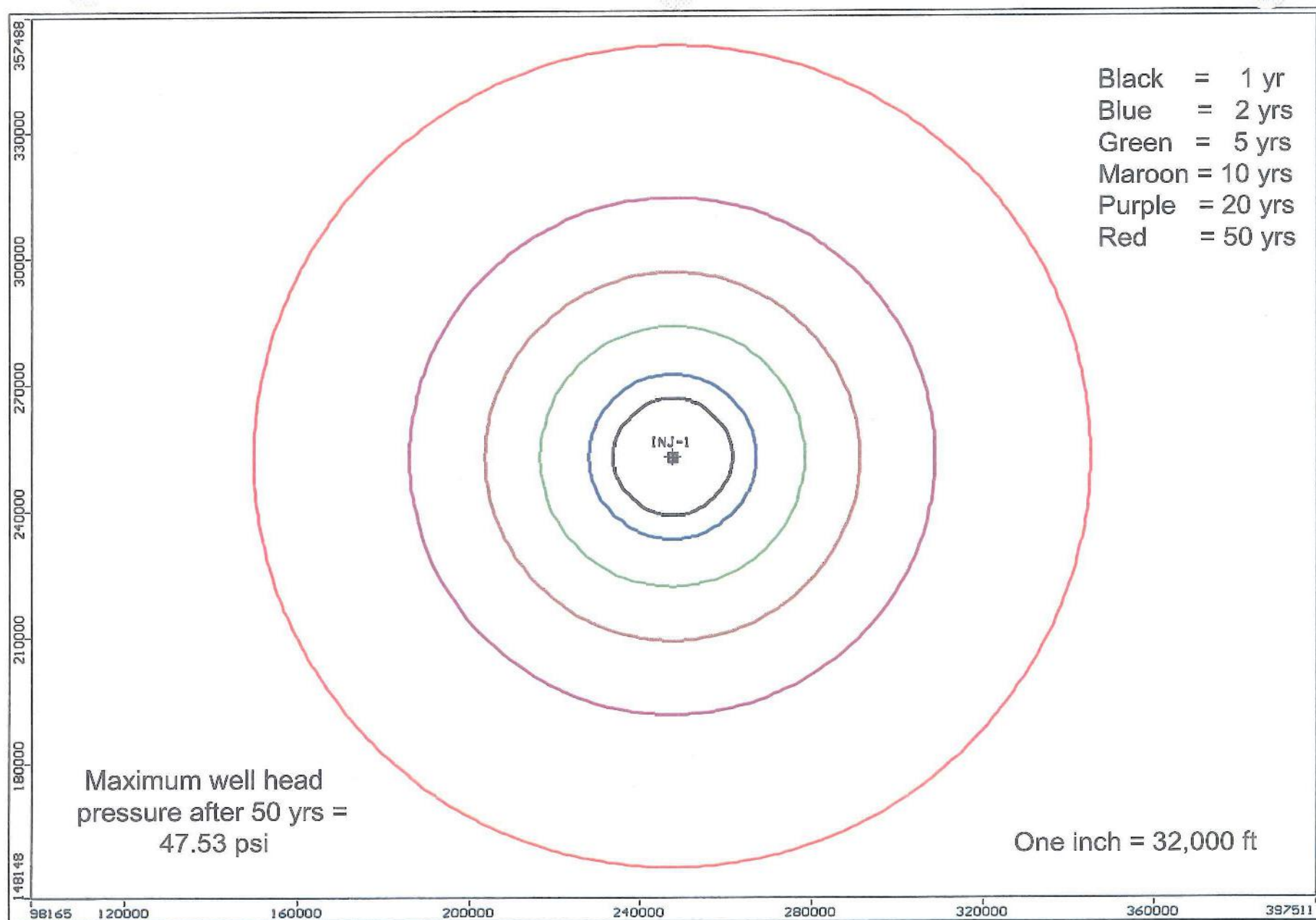


Figure 7 -- Contours of 1 psi for rate of 20 gpm for various periods of injection.

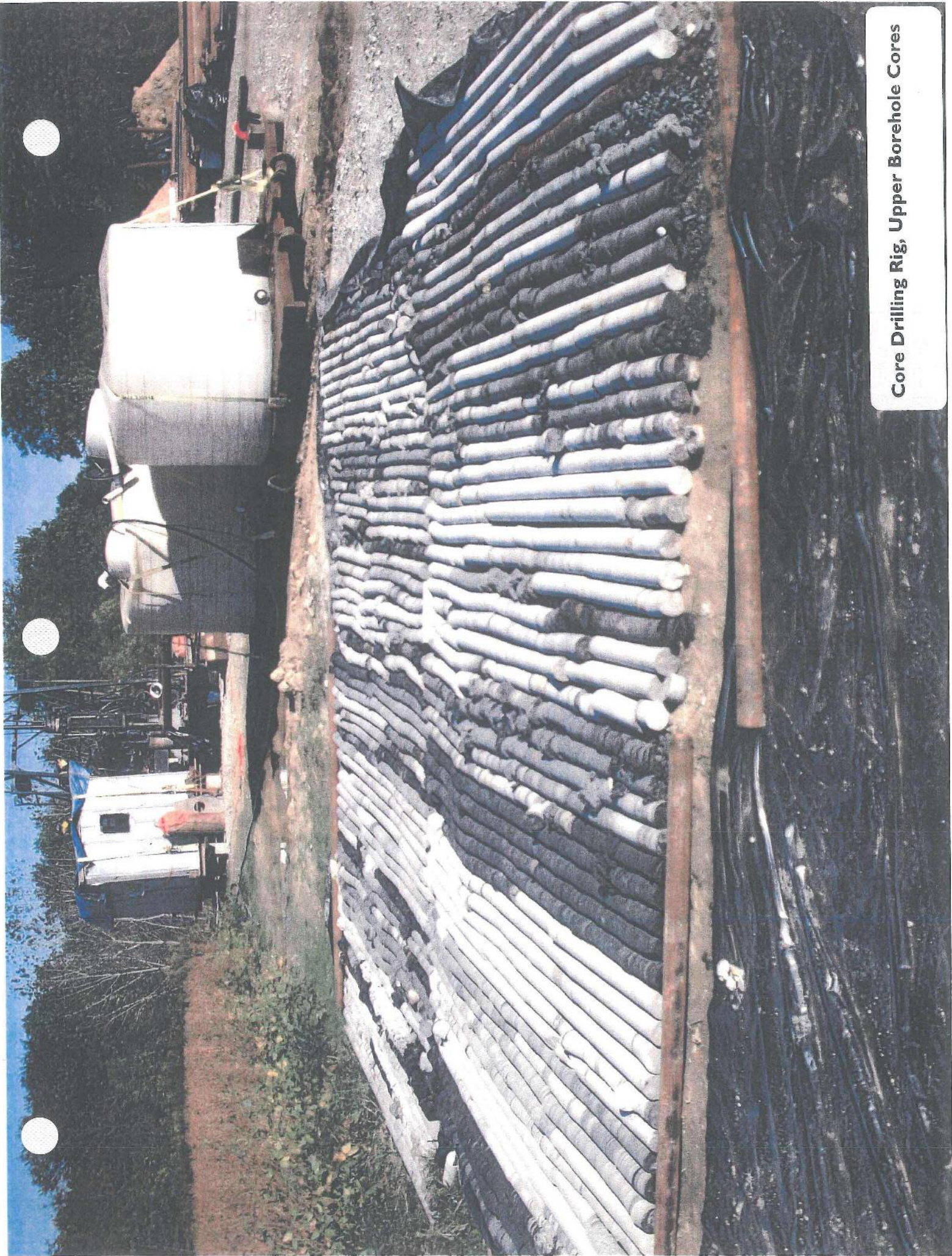
Appendix J

Site Photographs
(Drilling and Testing)



Drill Mud Settling Pits

Core Drilling Rig, Upper Borehole Cores



Upper Borehole Cores
Limestone, Shale, Coal
165' - 325'





Shale and Limestone Cores
774' - 864'



**Shale and Limestone Cores
864' - 1005'**



Ten Foot Cores
993' - 1134'



**Injection Test Flow Meter
Pressure Gauges, Valves and
Flow By-Pass Regulator**

Hook-Well Packer

